DECEMBER 1952

Journal

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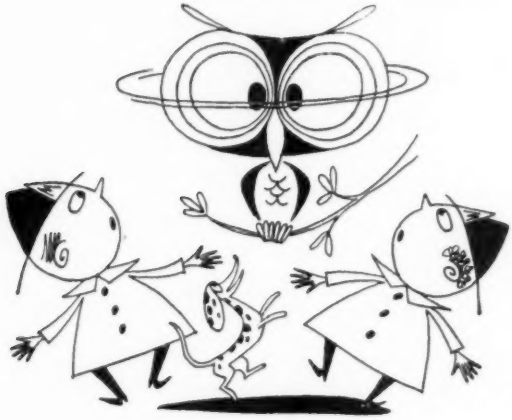
AMERICAN WATER WORKS ASSOCIATION

In this issue

Legal Problems of Water Works	Murdoch
Care of Mechanical Equipment	Rian
Louisville Billing and Accounting Practices	Payne
Multiple-Treatment Units	Aldrich
Radial Collector Wells	Gidley
Spring Taste and Odor Problems	Panel Discussion
Ozone Action on Tastes and Odors	Powell, Drummond, Saavedra, Evans, Fisher, Morgan
Selling Rate Adjustments	Panel Discussion
Slurry Feeding of Activated Carbon	Baylis
Control of Fluoridation	Jacobson

Head turns all the way around



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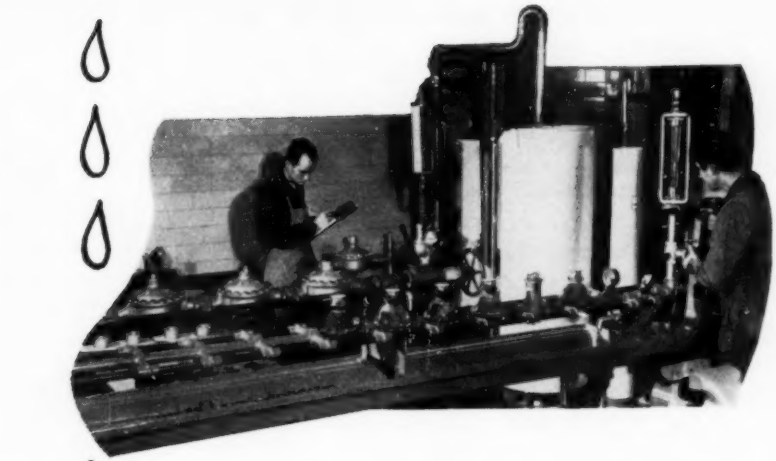

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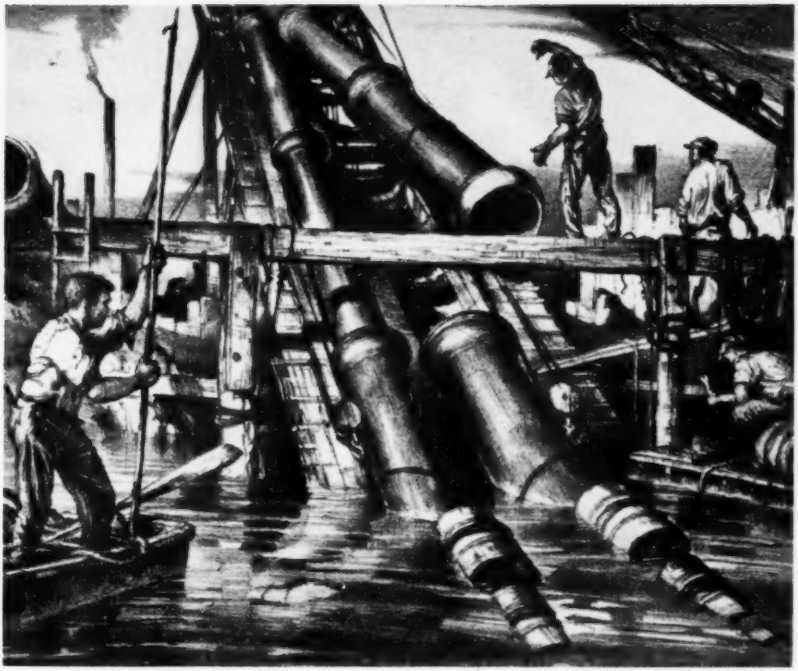

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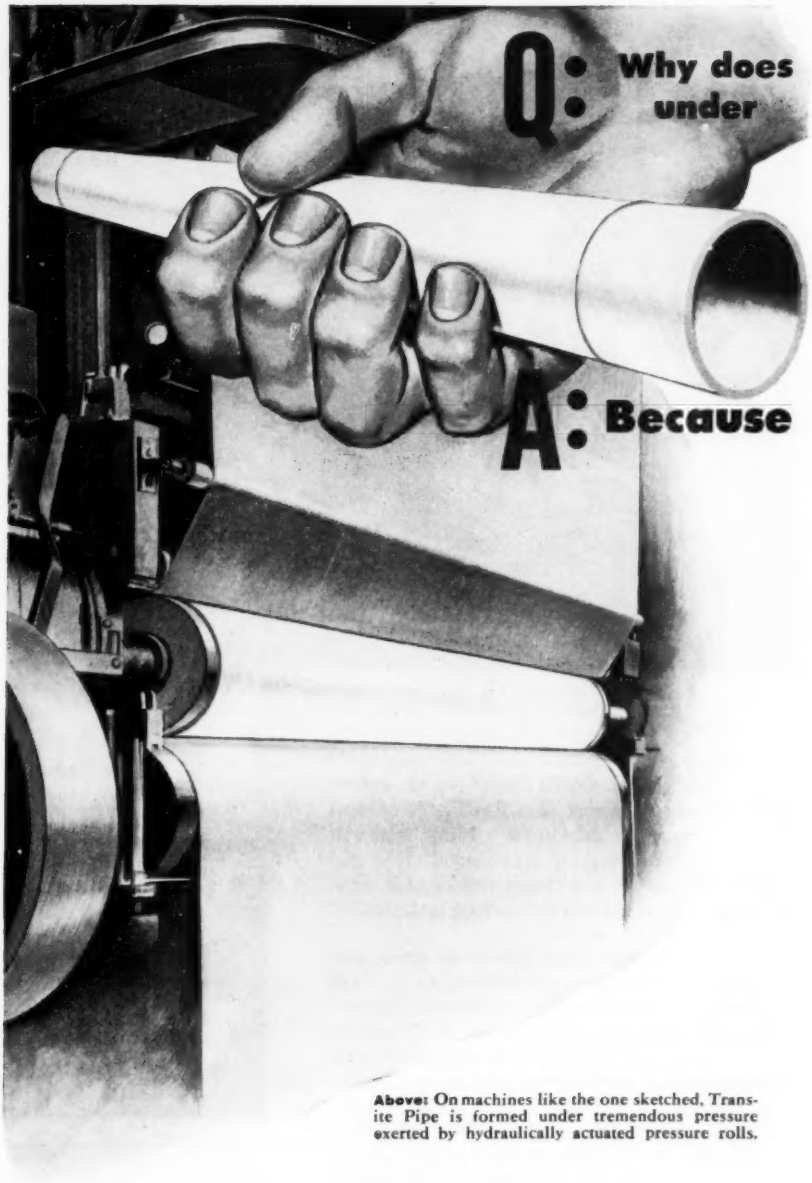

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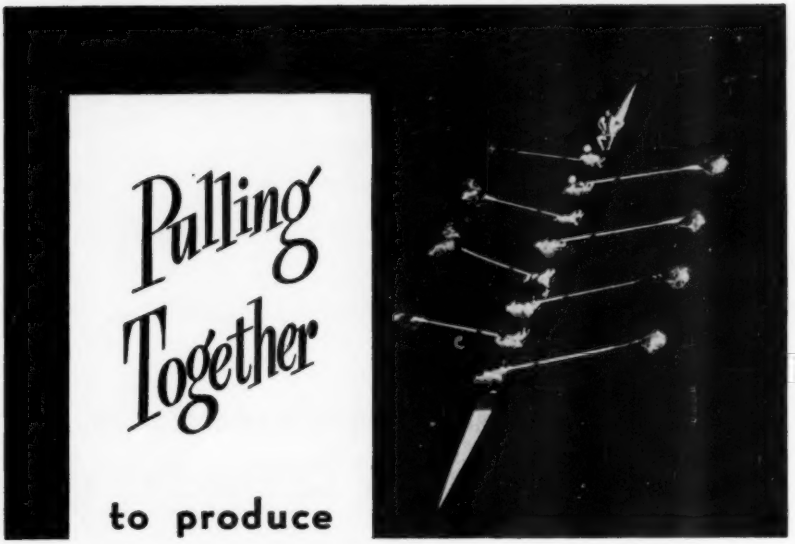

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Vol. 44 • No. 12

Contents

Legal Problems Confronting Water Works Management..JOHN H. MURDOCH JR. 1085
Use and Operational Control of Mechanical Equipment.....JOHN RIAN 1092
Billing and Accounting Practices at Louisville.....B. E. PAYNE 1099
Multiple-Treatment Units for Water Purification.....E. H. ALDRICH 1107
Installation and Performance of Radial Collector Wells in Ohio River Gravels
H. K. GIDLEY 1117
Taste and Odor Problems During Spring Runoff
JOSEPH F. ERDEI, GEORGE S. LEE, LEO LOUIS, & JAMES A. SAMPSON 1127
Action of Ozone on Tastes and Odors and Coliform Organisms
MARCUS P. POWELL, KENT G. DRUMMOND, CESAR SAAVEDRA, FREDERICK M. EVANS, NEIL B. FISHER, & PHILIP F. MORGAN 1144
Selling Rate Adjustments to Citizens
LEONARD N. THOMPSON, MORRIS S. JONES, J. CLARK KEITH, A. P. KURANZ W. R. LADUE, & C. F. WERTZ 1151
Chlorine Controls Revoked 1160
Slurry Feeding of Activated Carbon.....JOHN R. BAYLIS 1161
Control of Fluoridation.....ROBERT S. JACOBSON 1169
Revision of Reinforced Concrete Pipe Specifications..... 1173
Binding the Year's Journals..... 1174
1952 Conference—Kansas City..... 1175
Papers Scheduled at 1952 Section Meetings..... 1185
Index for Volume 44, 1952:
Subject Index..... 1199
Author Index..... 1208

Departments

Officers and Directors ..... ii, iv
Percolation and Runoff 1
The Reading Meter 20
Membership Changes 30
Condensation 40
Condensation Index 46
Section Meetings 68
Coming Meetings 86

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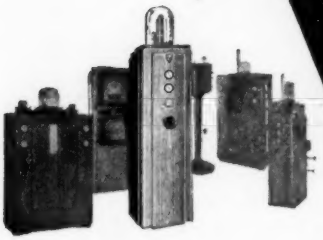

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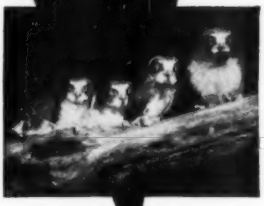

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Journal
AMERICAN WATER WORKS ASSOCIATION
VOL. 44 • DECEMBER 1952 • NO. 12

Legal Problems Confronting Water Works Management

By John H. Murdoch Jr.

A paper presented on Sept. 16, 1952, at the Kentucky-Tennessee Section Meeting, Knoxville, Tenn., by John H. Murdoch Jr., Vice Pres. and Counsel, American Water Works Service Co., Inc., Philadelphia.

TO keep this paper within tolerable length, consideration of many interesting legal problems must be omitted entirely and the answers to some of those studied must be indicated by statements of general legal principles applicable to a wide variety of factual situations. Two subjects will be discussed: [1] water works liability for damages caused by negligent operation; [2] weighing the public interest in water supply against property rights. Usually the term "water works" will be applied, without distinction, to both publicly and privately owned systems, and will mean an enterprise offering public water supply service.

Water Works Liability

In the law of negligence there are certain words and phrases which are used so often that a knowledge of their meaning is essential to an understanding of the statements of legal principles in which they are used. The first word to be defined is "negligence." Negligence is the failure to observe, for the protection of the interests of another person, that degree of care, precaution, and vigilance which the circumstances justly demand, whereby such other person suffers injury. Negligence is the absence or want of care which a reasonable man would exercise under the circumstances (*Maternia* v. *Pennsylvania Railroad* 358 Pa. 149). Any conduct which falls below the standard established by law for the protection of others against unreasonable risk of harm is negligence.

This definition of negligence in turn calls for a definition of the phrase "standard of conduct established by law." It means such course of conduct as would be followed by a reasonable man under like circumstances. Who is a reasonable man? He is a person exercising those qualities of attention,

knowledge, intelligence, and judgment which society requires of its members for the protection of their own interests and the interests of others. Negligent conduct may be either: [1] a failure to do an act which is necessary for the protection or assistance of another and which the actor has a duty to do; or [2] an act which the actor as a reasonable man should realize involves an unreasonable risk of causing an invasion of an interest of another.

The last definition can be understood only if "unreasonable risk" is defined. It means a risk which outweighs the values attached to the conduct which involves it. "The operation of railways and other public utilities, no matter how carefully carried on, produces accidents which kill or harm many people, but the risk involved in the operation is more than counterbalanced by the service which they render to the public" (Restatement of the Law, Torts, Section 292). Because of this counterbalance in favor of the operation, it is not an unreasonable risk which is involved. On the other hand, driving a car at 50 mph through a business street during the rush hour on a mere pleasure trip would be conduct involving an unreasonable risk of harm to others. The pleasure trip at that time, place, and rate of speed does not have enough social value to counterbalance the dangers involved.

In theory it is probable that all conduct involves risk, but a reasonable man need weigh only those circumstances which he knows or should know at the time of his action. A reasonable man is not assumed to be all seeing, all knowing or clairvoyant. He need not refrain from conduct having social value because he fears there may be evil consequences traceable to elements in the circumstances which he does not know or could not know through the exercise of reasonable prudence.

Water Works Risks

In water works enterprises, the standard of conduct established by law is the course of conduct which would be recognized by good water works operators—considered as such by this Association—to be the course of action which should be followed by a fellow water works operator under the circumstances. A water works operator is negligent when he fails to act or when he acts in a way which does not measure up to what well-grounded, careful, considerate, but active water works operators think should be proper action. Particular attention is directed to the definition of unreasonable risk as "a risk which outweighs the value attached to the conduct which involves it."

Many water works operations involve elements of risk, but if the community considers that the social value of the operation outweighs the risk of harm, then water works operators are not guilty of imposing an unreasonable risk on others by carrying on those operations. The water works is liable for damages only if water works action caused the damage and if the action involved an unreasonable risk. Thus, a high-pressure water line in a business street may burst. There is, therefore, a risk in placing such a line in such a place, but the community needs that line in that street and the utility of having the line there—its social value—outweighs the risk of harm. The act of placing the line does not impose an unreasonable risk. If, despite the fact that the line was properly installed and the pipe was of proper class for the conditions, it bursts and floods adjacent basements, there is no negligence and no liability for damages. On the other

hand, if the line was improperly laid on an unsound and unstable foundation and injury is caused by a resulting break and flood, then damages could be collected because the lack of care in laying was an act which imposed an unreasonable risk and was not up to the standard of a reasonable man.

The same legal principles are involved in passing upon questions of liability in other features of water works enterprises. If a water works operator knows, or by the exercise of reasonable care should know, of dangerous conditions and fails to correct them, the water works would be liable for damages to one injured if the injury was caused by the dangerous condition. Broken, sunken, or protruding valve box or meter box covers are typical examples. Slight irregularities in a pavement resulting from such box covers can probably never be avoided, and would probably be held not to impose an unreasonable risk on pedestrians or drivers, but an irregularity which is so pronounced as to make injuries a probability and which has existed for a substantial length of time so that the water works men should have seen it and repaired it, would impose an unreasonable risk.

Connections between a public potable water supply and a nonpotable supply on the premises of a customer, or interior plumbing conditions or practices making back-siphonage of contamination into the public water system a possibility is a controversial point. If a waterborne disease developed as a result of such a condition, would the water works be liable? The point is controversial because some state departments of health seem to feel that the water works should assume the responsibility of making inspections of consumers' premises to discover and correct such dangerous conditions, whereas some water works officials feel that they have no responsibility beyond the service connection. In other words, there is controversy about what a reasonable man should do under the circumstances. Inasmuch as the author has, on other occasions, failed to agree with either of these positions, he has been subjected to fire from both sides. It is his opinion today—as it was years ago—that the conduct of a reasonable man would be to use ordinary intelligence, and, when such intelligence told him dangerous conditions existed, force correction or discontinue service. On the other hand, the author does not believe that the water works should allow the public to think that it polices the premises of its consumers, thus making itself liable for damages resulting from conditions of which it had no adequate means of learning.

A water works must, at its peril, furnish water which is safe for domestic use. It is also required by regulatory bodies and the courts to supply a water which is reasonably free of turbidity, color, taste and odor—that is, it must do the best it can in these respects, considering all the circumstances. It is not required to do what is practically impossible, and some variations in quality due to emergencies or drought are not normally considered evidence of poor management. The water works is not expected to deliver to all of its customers water of a particular character needed by some one or more of its customers. Thus, if a manufacturer requires water free from all color or having some other special characteristic not demanded by the customers in general, failure to furnish this special type of water would not be grounds for legal action. Once the manufacturer was led to expect and rely on the water works

furnishing such water, however, a reasonable man would notify the manufacturer, if possible, before a change in water quality took place in order to enable him to avoid loss.

Fluoridation

From the standpoint of a lawyer, the problems involved in fluoridation are problems which come under the law of negligence. For the purposes of this discussion, it is assumed that the community has taken all appropriate action to indicate a desire for fluoridation and that the equipment and methods to be employed have been approved by the proper health authorities. It is also assumed that the general community recognizes that the addition of fluorides to the public water supply in the indicated amounts will probably result in some significant increase in tooth mottling. It is assumed that in addition to this recognition, there is the belief that the program will result in a substantial reduction in tooth decay, at least among the children, and that there are good prospects that the benefits to the children will carry over into their adult life. It is also assumed that the water works operator and the public know that continued overdosage of the water for a long period would cause a serious and distressing increase of tooth mottling, but that no known adverse side effects are to be anticipated from the program if only proper quantities are added to the water. It is assumed that the public health scientists have established these points to their satisfaction and that their findings have been published and not successfully attacked.

Under these conditions, it is clear that the water works operator is acting as a reasonable man would, and is not exposing his customers to an unreasonable risk when he undertakes to carry out the program as planned. The community has weighed the social advantages of reduction of tooth decay against the risk of some increase in tooth mottling and has chosen fluoridation. Those who suffer tooth mottling as part of the small group so affected would have no right of action against the water works —they had not been subjected to an unreasonable risk. If a very large proportion of the people developed mottled teeth after the program was put into effect, the experts would be justified in the opinion that the water works had been negligent over a long period of time and had put excessive quantities of fluorides into the water. The water works manager knew the danger and knew that the risk of such a result was not outweighed, in the minds of the community, by the reduction in decay; therefore, the water works would be subject to damages. The water works would be found to have acted negligently in permitting the excessive dosage over a long period. The excessive dosage, not the engaging in the approved program, imposed the unreasonable risk on the community. In view of the assumed scientific determination that the experienced results would not come about except after continued overdosage for a long period, the courts would probably say that negligence was the only inference that could reasonably and legitimately be drawn from the circumstances. The doctrine of "res ipsa loquitur" ("the thing speaks for itself") would apply and the time, place, and manner of the negligent acts would not have to be proved.

There would, however, be no liability if an entirely unforeseen adverse side effect developed, because an actor is only responsible for failure to consider circumstances which he knows or should know. The water works operator had no means of knowing that these side effects would develop. Therefore,

he was not negligent. To a lawyer the fear of successful suits for damages based on such unforeseen side effects seems groundless.

Public Interest and Property Rights

Two recent cases involving water works should be mentioned because, in deciding them, the courts applied legal principles which water works managers should know. The first case was decided by the Supreme Court of Errors of Connecticut at its June term, 1951, and the second by the Court of Appeals of Kentucky on Mar. 28, 1952, as extended on denial of rehearing on June 20, 1952.

In the Connecticut case the Greenwich Water Co. held a statutory right to take water from the Mianus River but this statutory right was subject to the riparian rights of owners of property along the river. That is, the water company had no legal right to divert the water of the river—as against those riparian owners—without purchasing or condemning the riparian rights. The majority of those riparian owners purchased, improved, and maintained their properties as country estates, counting on the river as one of the attractive features. Aside from swimming, use of water from the river for lawn and garden sprinkling, watering of chickens, and domestic sanitary needs, the owners valued the water for its enhancement of the beauty of their estates. The water company had not acquired the riparian rights. In 1949, a long period of severe drought began and the normal sources of supply for the company were either cut off or so reduced that emergency conditions for the community developed. By pumping some of the flow of the Mianus River, the company was able to maintain some service. Under these circumstances, a group of influential riparian owners went into court seeking an injunction to restrain the company from diverting any of the waters of the stream. (It is interesting to note that the trial court found as a fact that "a water company in the situation of the defendant should plan for a supply of water to meet conditions as they will be at least ten and preferably fifteen or twenty years in the future.") The trial court refused to restrain the pumping from the river and the riparian owners appealed.

The Supreme Court of Errors in its opinion stated:

> The diversion of the water was without any claim of right, was wilful and, *except for the consideration of the public interest* . . . was inexcusable. . . . It is well within the court's discretion to deny an injunction against the infringement of riparian rights if to grant it would *adversely affect the interest of the public.* . . . Under the circumstances . . . equity demanded that the defendant be allowed a reasonable time within which to make adequate compensation to the plaintiffs for the permanent taking of their water rights if it intends to acquire them, and, if that compensation is not made within such reasonable time, the defendant should be enjoined from further diversion of the waters of the stream. [Author's italics.]

In short, the court held that the temporary emergency invasion of the property rights of the riparian owners should not be restrained where such restraint would adversely affect the interest of the public. Water works managers must never forget the public interest—the public nature—of their work.

The second case is *Daugherty* v. *City of Lexington,* et al., 249 S.W. 2nd, 755. The opinion of the Court of Appeals of Kentucky, as extended on denial of rehearing, was delivered June 20, 1952. The case involved some very complicated questions on statutory law re-

garding zoning and even more complicated questions of pleading and practice, but none of these questions is of particular interest to water works managers. The point which is of great interest is the court's attitude toward a property owner's plan to develop his own property in such a way as to endanger a source of public water supply.

Daugherty sought a permit from the board of adjustment of Fayette County for the erection of a restaurant, gasoline station, and tourist cabins on his property, which was 1,100 ft from the reservoir of the Lexington Water Co. The elevation of Daugherty's property is between 20 and 30 ft above the water elevation of the lake. Daugherty proposed to care for the wastes from his development with two separate septic tanks, one of 1,000-gal capacity and the other of 500-gal capacity, each draining into a separate septic field of drain tile in crushed rock fill. The board of adjustment denied the permit because the proposed methods for water supply and disposal of sanitary waste had not been approved by the county health officer. That officer refused to approve those plans, saying that he thought only in terms of public health and safety and the topography of land in the proposed area. Daugherty contended that his proposed method of sewage disposal is completely adequate, modern, and as satisfactory and safe as it is reasonably possible to obtain; that it will cause no health hazard to the public generally; that the proposed use of his property constitutes a reasonable and natural use; and that to prevent him from so using his property, in order to protect the purity of the water in the reservoir lying below his land, amounts to a taking of his property without just compensation, not for the benefit of the public generally, but for the benefit of a private corporation. His pleadings did not allege that his disposal system would not endanger the purity of the water in the reservoir.

The point at issue on the aspect of the case in which water works operators are interested may be paraphrased from the court's opinion. Did the health officer and the board of adjustment act arbitrarily and unreasonably and with the sole purpose of protecting the private property of the Lexington Water Company? In answer, the Court of Appeals decided the case against the property owner and, in the opinion, made some very interesting and important points, which follow:

> The water company is in substance nothing more than a management corporation, allowed to make a reasonable profit for furnishing water to the city.
>
> The public has a direct interest in the preservation of the purity of the water in the reservoir of the Lexington Water Co. So Daugherty's right to convert his property to a commercial use must be measured against this public interest in determining this question of reasonableness.
>
> *He may not use his property in such manner as will endanger the source to which the public must look for its supply of water.* [Author's italics.]

This case indicates that a property owner not only has no right to contaminate a public water supply but has no right even to endanger it. The burden is on the property owner to prove that his proposed use will not endanger the purity of the water in a public supply. No longer, under this sound doctrine, will water works be compelled to wait until the purity of supply has been destroyed before taking action. The public interest comes first. The Kentucky decision is in line with, but in a sense a further development of, a doctrine announced in many other jurisdictions.

Other Court Decisions

Two older cases in Pennsylvania may be cited as fairly typical. In *Commonwealth* ex rel. *and Butler Water Co.* v. *Russell* et al, 172 Pa. 506, the Supreme Court of Pennsylvania reversed a decree of the lower court against the commonwealth and the water company and sent the case back for full hearing on the facts. The appellate court opinion suggested certain questions to be considered after the facts had been developed. It said one question was: "whether in other words, the Commonwealth, in the exercise of its police power, may not limit and restrict the individual in the exercise of admitted rights, when the welfare of the public requires it; or whether it is indeed true that the ownership of a few acres of land, or a leasehold interest therein, gives to the holder an unqualified right to destroy the water supply of a city. . . ." The court did not answer these questions directly but its thinking was indicated and was well understood. In *Pennsylvania Railroad* et al. v. *Sagamore Coal Co.* et al., 281 Pa. 233 (Cert. denied 267 U. S. 592) the Pennsylvania Supreme Court, in effect, gave direct answer to the questions suggested in the Butler case. In the opinion it was said, "It has always been under our law a nuisance to pollute a stream from which the public gets its supply of water. . . . There could not be such a thing in the law as a property right to do a wrong. . . . Our conclusion is that defendants have no right of any kind to drain their mine waters into the stream considering the public use which is made of its waters and that their doing so constitutes a nuisance which must be restrained."

There is no such thing as a property right to pollute a public water supply. Even to endanger such a supply may be restrained by the police power of the state and the affected landowner need not be compensated.

Other Problems

Only a very few of the legal problems of water works managers have been touched upon. The legal problems involved in keeping water works enterprises—both publicly and privately owned—financially strong enough to give the type of water service which the communities really need are the most pressing problems which face water works managers. Discussion of these problems would require much space and and so must be omitted. The impact of inflation on all water works operations when courts and regulatory bodies tend to give predominant weight to original cost deserves the careful attention of the water works man. If rates are based, in effect on the average net investment in utility plant and property, those rates must be adjusted upward very frequently. Otherwise new customers become a burden, because the increase in net plant and property per added customer goes up each year of inflation and is usually at least double the average investment per customer at any time. Furthermore, consideration might well be given by water works men to the legal problem of determining a fair rate of return. Is a rate fair which is merely equivalent to the rate of return now demanded by new investors who put in the presently devaluated dollars, if it is to be applied to existing investors in common stocks who put in the old-time, "100-cent" dollars? The older investor's ability to buy bread is lessened although he may have the same number of dollars. Wage earners get more dollars now than they did before inflation. Why not give the holder of common stocks of water companies the same hedge against inflation?

Use and Operational Control of Mechanical Equipment

By John Rian

A paper presented on Feb. 9, 1951, at the Indiana Section Meeting, Indianapolis, Ind., by John Rian, Dist. Supt., By-Product Plant, Northern Indiana Public Service Co., Hammond, Ind.

THE increasing demand of industrial production and the effect of competition in the American way of life are stressing the need for water utility facilities to serve adequately beyond designed expectations. While looking ahead and planning for expansion of facilities, it is well to review those at hand to be certain that every available space or capacity to serve is utilized. Not only must there be capacity to serve, but the service is required to satisfy at least the "Rules and Standards of Service for Water Utilities of Indiana," compiled by the Public Service Commission of Indiana. Records of customer complaints, meter tests, water quality, main flushings, pressures, customer billing, customer deposits, discontinuance of service, interruptions of service, accidents, contracts for service, main extensions, and service rates are required to be kept in good order for examination by the commission or its representative at any time. The accounting of activities should satisfy the method prescribed in the "Uniform System of Accounts for Water Utilities" compiled by the National Assn. of Railroad and Utilities Commissioners. The tangible plant, consisting of land, structures and improvements, power production and pumping equipment, purification and distribution systems, and transportation, work, and office equipment, must be kept adequate and in good order so that the maximum service will be obtained from it.

This tremendous demand for service requires the most exacting control, coordination of activities, and a true sense of obligation. The demand is most successfully met within the required time by pressing into service mechanical equipment designed for a particular service, such as the typewriter, calculating and billing machines for the office; automotive equipment for transportation; and power-driven machinery, including mechanical outfits and tools, for production, pumping, purification, distribution, and shop work. So important is the contribution of mechanical equipment to successful operation that it is well to evaluate its use and control to be certain that it is giving the maximum amount of service.

Factors in Operational Control

The job to be done should justify the use of the equipment employed. There are tasks that are done more economically within the required time without the use of mechanical equipment. In an office, an adding or calculating machine would not be employed

to add or multiply a few simple figures for estimating purposes. In the field, when making a shallow excavation, a crane would not be considered. The use of such equipment, when justified, results in promptness of execution at minimum cost.

The work output of equipment is dependent on the individual at its controls. An inefficient operator will retard production and permit unnecessary strain and wear, shortening the service life of the parts. The operator should be given careful consideration; he should qualify physically, be mechanically inclined, like the work, be able to learn, and be given the opportunity to obtain the knowledge required by the position.

The choice of equipment should be made on a competitive and equitable basis. Demonstrations, careful examination of the design, a knowledge of the parts, and the reputation of the manufacturer are important. The experience of others, through an observation of the operating records of the equipment, should be considered before the choice is made.

Three principal factors—people, material, and knowledge—are necessary to the successful use and control of equipment. The importance of one factor over another or the order of their importance should not be considered. To enjoy the maximum benefit from the investment, all three factors must be utilized to the fullest.

People

The machine will produce no more than it is permitted to produce by the person at its controls, no matter how perfect the application, design, construction, or record of its performance. The individual should be fully qualified. His obligation is to allow the machine to operate normally at the designed capacity and maximum amount of time. Unnecessary delays caused by the operator should be held to a minimum.

Prospective employees ought to be presented with an explanation of the obligation they are required to assume. After an employee is hired, it is important to have the understanding that the selection is on a trial or probationary basis during the indoctrination period. This period will show whether the individual qualifies physically and mentally, is mechanically inclined, has ability to learn, and is receptive to the necessary training.

Evidence of good character, promptness, and dependability is important. The worker should be encouraged to practice courtesy, respect, and consideration in every contact, not only with people, but also with all facilities.

Questions should be encouraged and information supplied promptly and freely. Sincerity of purpose, justification of every effort, and knowledge of the consequence before performance of an operation should be reflected by the individual. Enthusiasm and its effect upon others are important contributions to better operation. The workman is the all-important producer. He is assisted through the levels of foreman, supervisor, and management. Desirable traits can be encouraged. The foreman should enthusiastically report any exceptional practices to the supervisor, and he should insist upon seeing evidence of the practice.

Material

Good material in tested, precision-made parts of the required design, carefully assembled, will contribute to the normal use and operation of equipment. The reputable manufacturer

will carefully analyze all forces to be overcome by the parts, and will provide for the resistance of these forces by the proper and economical application of the correct material. The stress produced in a part, depending upon the arrangement and direction of the external forces, may be tensile, compressive, shearing, bending, torsional, or a combination of these, such as tensile and bending, which produce a bending of the member, and, at the same time, an elongation or compression. Other conditions under which external forces are applied include impact, repeated stress, and column action, all of which tend to make the parts fail.

Materials vary greatly in their behavior under stress. Common characteristics include elasticity, plasticity, ductility, brittleness, stiffness, flexibility, toughness, malleability, and hardness. The extent to which a material recovers its original form after being subjected to and relieved of external forces is a measure of its elasticity; the extent to which recovery fails is a measure of its plasticity. Wrought iron, soft steel, and copper are ductile; they can be drawn out without necking down. Cast iron is a brittle material having a considerable amount of plasticity. Mild steel and wrought iron are tough materials that will withstand heavy shocks. Copper is very malleable; it can be hammered into thin sheets, whereas wrought iron and soft steel are malleable at ordinary temperatures but are more easily worked at red heat. Manganese, chrome steel, and white cast iron are hard materials which offer good resistance to scratching, denting, and abrasion.

Accordingly, only equipment designed and assembled with parts tested to specifications based on the task to be performed should be selected. The factors considered by the manufacturer in producing the equipment and the recommendations for its operation and care should be fully understood and

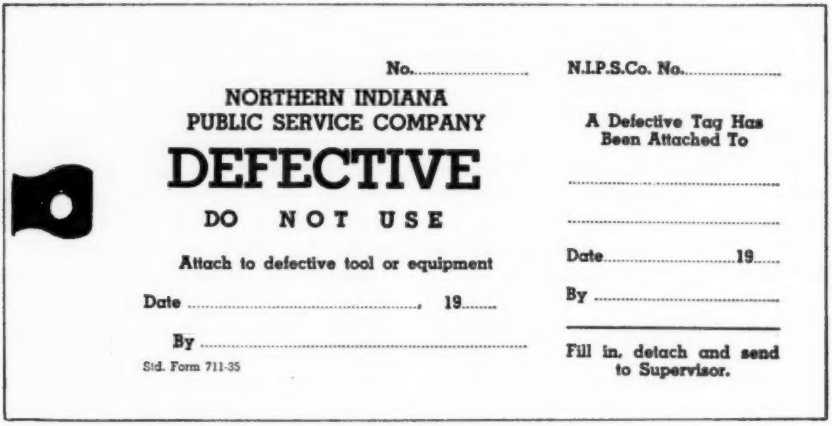

Fig. 1. Defective Tool and Equipment Tag

The tag is filled in, and attached to the defective equipment, part, or tool. The stub is detached and sent to the supervisor.

followed. Each part in the assembly must have the attention necessary to assist it in the performance of the duty for which it was designed.

Knowledge

Understanding and wisdom, not unawareness and ignorance, are essential to individual success. Engineering, education, and enforcement will stimulate an interest in the use and operation of equipment. Neither engineering nor education can be neglected, but to assure normal use and control, enforcement, through the crew foreman, supervisor, and management, should be improved. The right kind of enforcement is necessary. To achieve understanding and a happy relationship, enforcement must be wise and of a type acceptable to the individual.

On-the-job training must be well engineered to promote job interest which will be manifested in study, thought, and practice. There is need for more effective and efficient instruction or training of the individual. The ever-increasing pressure for service is a continuous warning that it is good intelligent business to train department heads to be department heads, foremen to be foremen, and the individual employee to be a better worker. There is need for training regardless of the amount of experience of the individual because training will result in stepped-up efficiency.

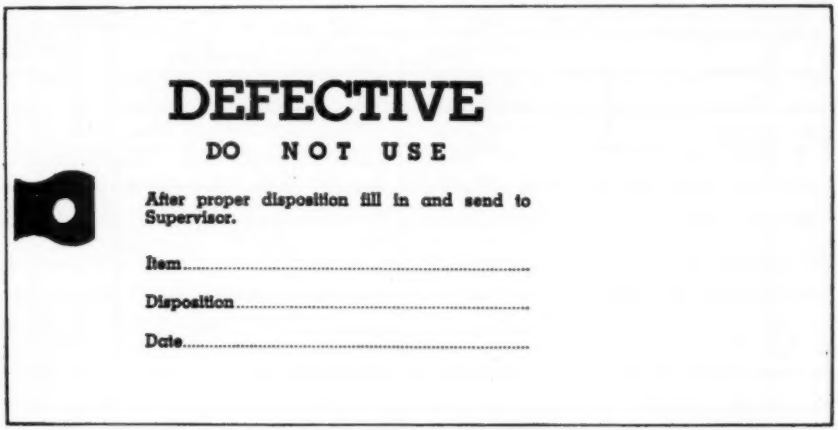

Fig. 2. Defective Tool and Equipment Tag

This side of the tag is filled in after the correction is completed. The tag is then forwarded to the supervisor where it is reviewed with the stub previously sent to the supervisor and filed for the record.

Instruction requires leadership and guidance of the thinking and actions of the individual in order to establish desire, willingness, and eagerness to achieve results. There is a greater differential in attitude than in ability or intelligence between an employee who accomplishes his task properly and one who does not. Those who have the desire and the determination to succeed get the most out of instruction or training. Intelligence, certainly, is important, but often overrated. Many peo-

STD. FORM 711-33

NORTHERN INDIANA PUBLIC SERVICE COMPANY

Quarterly Tool and Equipment Inspection Report

Personal and Company Owned

District ..... Department .....

Foreman ..... or Car .....

All Tools and Equipment Inspected and found Satisfactory except as follows:

UNSAFE TOOLS AND EQUIPMENT				Use ✓		
QUAN.	TOOL	DEFECT OR CONDITION	CAUSE	TOOKED	REPLACED	REPAIRED

Remarks

These Columns To Be FILLED OUT By SUPERVISOR WHEN COMPLETED

Date 19 Inspectors

Foreman 19

Fig. 3. Quarterly Tool and Equipment Inspection Report

This form is completed by the inspectors. The completed original copy is filed in the life file of the equipment for the record.

ple have far more ability than they will ever use, but are not sufficiently supplied with the drive and push for success in learning.

The learner or student must be at ease and have the desire and willingness to receive information. To achieve this receptive attitude, surrounding conditions must be favorable for learning, and the importance of the information—the need for it, and how it affects the learner personally—must be stressed.

Comprehension will be most nearly complete if the instruction is both verbal and graphic. The information should be thoroughly explained, illustrated, demonstrated, and discussed in sufficient detail. The learner should be allowed to apply what he has learned. Any errors should be corrected immediately. Practice should be continued until errors have been eliminated and the learner is confident he has complete comprehension and satisfactory control. The learner should be checked occasionally to determine whether the information has been retained and if there is evidence of it in his performance. Learning is a continuous process of experiencing many small successes and failures. Failures do not indicate total loss as long as they challenge, encourage, or induce additional will to succeed. The practice of fault-finding is not effective and must not be permitted because it simply puts a person on the defensive, causing him to defend his performance rather than to improve his method. Mistakes should be treated on an impersonal basis, and improvements should be given a personal touch through generous compliments when deserved. Compliments are stimulating and get results, but fault-finding is detrimental and nonproductive. Commend individually and collectively when operations are well done.

Performance

The normal operating condition of equipment should be maintained by thoroughly understanding and following the instructions and recommendations of the manufacturer. Manufacturers' recommendations are the best text and guide to achieve the results the equipment is designed to produce. Extreme care in the handling of equipment should be practiced to avoid introducing hazards from which injuries and property damage may result. The schedule for lubricant application and parts inspection should be strictly followed. When adjustments are found to be necessary, they must be made without inexcusable delay. When defects are found, they should be reported and made a matter of record by an approved, practical, and positive procedure, and corrections should be completed, recorded, and reported as soon as possible. Records should be maintained for convenient reference throughout the life of the equipment. The parts performance summaries benefit both the purchaser and the manufacturer as they indicate what improvements may be desirable, and assist in future purchases of equipment.

Figure 1 shows the tag used for reporting, correcting, and recording defects in equipment. This side of the tag contains space for the tag number, the date, and the signature, and, on the stub end, information for the supervisor. Figure 2 shows the other side of the tag, which has space for the item, disposition, and date.

The defective equipment, part, or tool is tagged by the man in charge

after writing in the information on the tag and stub. The stub is detached and sent to the supervisor. After the correction is complete, the tag is removed, the additional information is written on it, and the tag is forwarded to the supervisor where it is reviewed with the stub and filed for the record.

Figure 3 shows a method by which periodic inspections and corrections of equipment can be reported and made a part of the permanent record. This form is called the quarterly tool and equipment inspection report.

The inspection report spaces are completed by the inspectors on an original and one copy, both of which are given to the foreman who is chairman of a regularly scheduled group safety meeting. The foreman oversees the correction and, when completed, he: notes in the "Use" column whether the equipment was junked, replaced, or repaired; signs and dates both sheets; keeps the original for use in the next scheduled group safety meeting; and forwards the completed copy to his supervisor. The supervisor checks and initials the copy, and forwards it to the safety supervisor. The completed original copy is filed in the life file of the equipment for the record.

Conclusion

The use and control of mechanical equipment, regardless of type, size, or application, should receive the necessary attention so that the equipment will function normally with minimum expense. In the water utility industry, almost every material item, except land, structures, and supplies, can be classed as mechanical equipment. Equipment used in the source of supply, purification, pumping, and distribution systems includes valves, hydrants, motors, pumps, controls, radiophones, boilers, cranes, bulldozers, compressors, trucks, automobiles, valve-inserting and operating machines, drilling and tapping machines, derricks and winches, leak and pipe locators, hand tools, billing and calculating machines, and typewriters. Efficient operation of mechanical equipment will contribute to the lower overall cost of water utility operations.

Billing and Accounting Practices at Louisville

By B. E. Payne

A paper presented on Oct. 24, 1950, at the Kentucky-Tennessee Section Meeting, Memphis, Tenn., by B. E. Payne, Chief Engr. & Supt., Louisville Water Co., Louisville, Ky.

LIKE a great many other water systems, the Louisville Water Co. has increased the number of properties served to the extent that certain growing pains have resulted. This expansion, plus the added duty of collecting sewer service charges for two separate sewer-operating organizations, has forced improvements in the billing, collecting, and accounting practices. This paper describes some of the methods used by the commercial department of the Louisville Water Co. in handling its 90,000 metered accounts.

Districts

The accounts are grouped into 33 geographical districts designated by letters. Two districts containing the larger accounts, those regularly consuming more than 100,000 gal per month, are read and billed each month. Another district, composed of well supply users to whom no water bills are sent but who must be billed for sewer services, is also billed each month. The other 30 districts are divided into two groups which are read and billed on alternate months.

Account Numbers

Each service is designated by two serial numbers which are assigned when a service application is made. These numbers are recorded on a set of city maps which show all buildings and form the basis of all files and records. The attachment number is the service serial number, which is the historical file number for that service and remains with it as long as the service exists. The account number is the order in which the meters in a particular district are read and the order in which the pages in the meter-reading book are arranged. These account numbers may be changed from time to time as new areas are integrated into the district. All changes and new assignments originate in the engineering department. Orders for changes are recorded on the maps and changes are simultaneously made by all groups concerned. Inasmuch as the account number is the meter-reading book page number and the order in which all billing and accounting records are filed, it is the key to all activities of the commercial department.

Meter Reading

The meters are read by districts by nine two-man crews composed of a reader and a helper. Each crew completes an average book of approximately 250 meters each day, recording the meter reading and consumption for the period.

After reading, each meter book is checked by clerks in the meter-reading

department for errors in subtractions, high or low readings, and skipped readings. An effort is made to correct any errors by sending out inspectors to check readings. These clerks also compute the consumption and billing of accounts composed of more than one meter, combined services, and large accounts. The number of accounts in each book are counted and noted each period. The meter books are now ready for the billing department.

much useful and important data are obtained. The material which follows describes in detail the operation of this equipment as developed at Louisville.

Advance Card File

When the checked meter books are delivered to the billing department, the stage has already been set by having in the files from the previous billing period the name-and-address punched card, arranged in account number or-

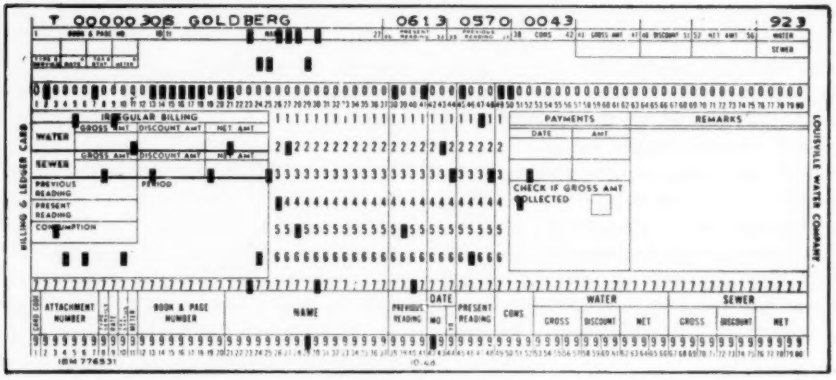

Fig. 1. Billing Card

This card contains information on the type, rate and use classification, account number, customer's name, previous meter reading, sewer charge designation, and other special coding.

Machine Billing

The operations of the billing department are particularly interesting inasmuch as punched-card machine billing * is comparatively new in water works operations. The author has been very favorably impressed by the speed, accuracy, labor, and space economy as well as the ease with which

* Products of the International Business Machines Corp., New York, are used. The use of such machines at another utility has previously been described by Weir (1).

der. Any cards that have been added or changed during the period are filed in the back of the drawer.

The advance billing cards are arranged in the same manner in another file. The name-and-address card is a perforated card interpreting on the top line the name, mailing address, service address, city, account number, and other coding.

The billing card (Fig. 1) is also a perforated card and, at this point, is called the "advance card." This card

contains information on the type, rate and use classification, account number, customer's name, previous meter reading, sewer charge designation, and other special coding.

Key Punching

The billing process starts with the punching of the current meter reading and the consumption from the meter book page into each of the above-described advance cards. There must be a card for each page in the meter book and a page for each card. This work is done by one operator on an electric card-punching machine at an average rate of twelve books or 3,000 cards per day. Inasmuch as the cards and the meter book pages are in the same order, this operation is almost mechanical.

Checking Tabulation

These punched advance cards, now termed billing cards, are then checked by an automatic checking tabulator. The subtractions between the present and previous meter readings are checked and cards containing error or irregularities are offset in the completed deck. The number of cards processed and the total consumption shown by the billing cards are given by this machine. This number is checked against the number of meter book pages in the book or district as previously counted by the meter book checkers and is listed on the fly leaf of each book. Any errors are checked and reconciled and totals are corrected before the next step is started.

Sorting Out "Off" Accounts

The billing cards are then sorted on an electric punched-card sorting machine. The "off" accounts are sorted from the active billing cards. These "off" account cards are run through the checking tabulator to get the number of "off" accounts not to be billed. This number is subtracted from the total number to give the number of bills to be made and to insure that no consumption has been punched into a coded "off" account card.

Sorting Out "Irregular" Accounts

The remaining billing cards are then run through the sorter again and the irregular billing cards are sorted out. These irregular billing cards have had the money figures—gross, discount, and net, both water and sewer—previously punched into them by the key punch operator from figures prepared by the meter book checkers. These cards are now run through the printing tabulator where the number of accounts and the money figures are printed and crossfooted to check with a tape recorded by the clerks that figured them. This operation checks all computations and copying on these accounts.

Sorting for Rate Classification

The remaining billing cards are then sorted into class and rate groups—that is, city, county, or boosted pressure and 1,000-gal consumption groups. The rate cards are then sorted in ahead of each rate group of billing cards. The rate cards, one for each 1,000 gal of consumption and rate class, have the money figures—gross, discount, and net, both water and sewer charges—already punched into them.

Reproducing Money Figures

The combined deck of cards is now fed through the electric card-reproducing punch machine where the

money figures already on the rate cards are reproduced on each of the billing cards that follow that rate card. Then the correctness of the punching is checked against the rate cards by the same machine by comparing the consumption and money figure punchings.

Sorting for Billing

The cards are next run through the sorter again to remove the rate cards which are filed in proper order for use with the next batch of billing cards. The irregular billing cards are added to the deck during this sorting and all billing cards are rearranged in account number order by re-sorting.

The "no sewer charge" account cards are sorted out after all cards are in proper order. These cards are then gang-punched to code punch the cancellation of all sewer charge figures that have been punched into them. These cards are then collated into the proper account number order with the rest of the deck by the electric punched-card collator.

Collating Name-and-Address Cards

The name-and-address cards are then taken from the files and those cards changed or added since the last billing are collated into the rest of the name deck by account numbers and checked for sequence. The billing cards are matched with the name cards in the proper account number order. Any name card for which there is no billing card will be rejected and must be matched against any "hold" bills or "off" accounts. The number is checked back to the adjusted number of accounts previously noted. The billing cards and the name cards are at that point in exactly the same order. The number of each is correct and the

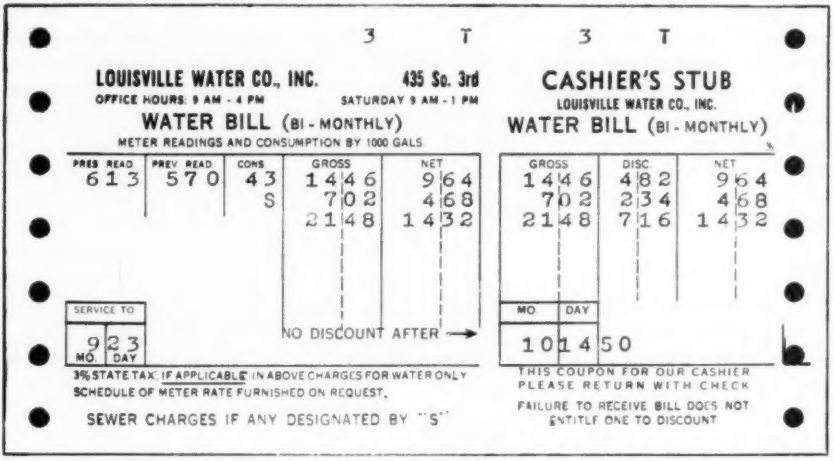

Fig. 2. Money Side of the Postcard Bill

The money figures, the meter readings, the consumption, the date to which service was rendered, the month and day of last discount date, and the account number are printed in the proper spaces on the bill form.

consumption and money figures have all been mechanically checked. The records are complete and the bills can be printed.

Making the Bill

The money side of the postcard bill (Fig. 2) is first printed by feeding the continuous postcard bill form through one side of the printing tabulator or accounting machine while the billing cards previously described are fed into another part of the machine. The desired money figures, the meter readings, the consumption, the date to which service was rendered, the month and day of last discount date, and the account number are printed in the proper spaces on the bill form in one operation. This machine also gives the total results, including the number of accounts, total consumption, total net water revenue, and total net sewer revenue. The number of accounts and total consumption are checked against previous steps to make sure that no cards have been left out.

Addressing Bills

When the billing side of the postcard continuous form is completed for the district, the bill forms are started through the same printing tabulator again in an inverted position, but this time with the name-and-address punched cards. Because the name cards are in the same order as the billing cards, and hence the printed bills, the correct name and address are printed on the back of each bill. Spot checks are made to make sure that this operation is taking place properly by comparing the account numbers which appear on both sides of the bill. After this process is completed, the total number is taken and checked against previous counts. The paper bills are made in the same manner on the same machine except that the billing card and the name cards are so grouped, one behind the other, that the bill is made and addressed in one operation.

New Advance Cards

While the names and addresses are being printed on the bills, the billing cards are put into the reproducing punch and new advance cards are made. All punchings except consumption and money figures are reproduced and the present meter reading is punched as the previous reading. These advance cards are then run through the interpreter, which prints the account number, name, and previous reading on them.

Accounting Card

The current billing cards are sorted to separate the "no sewer" account from the "sewer charge" accounts. These sewer charge accounts are interpreted to print the attachment number, class group coding, and the gross, discount, and net sewer money figures on the second line of the card. This punched billing card has thus become the accounting card.

Separating and Mailing

As all bills are in a continuous form with perforated edges, they are put through a bursting machine, which trims and separates them into individual regulation postal cards. As individual postcards, they are run through the stamp cancellation machine and are then ready for mailing. Certain special bills, such as those to be charged to a bank account, duplicate requirements, out-of-town bills, and government bills, are coded by a number on the left-hand edge on the address side to facilitate hand sorting. "Charge to

bank account" bills are stamped "paid," treated as checks, and deposited. Duplicate bills are made by hand. All extraneous matter must be removed from the address side of out-of-town bills. The U.S. government bills require a certification stamp.

Consumption Report

After the bills are completed, the billing cards are used to obtain various reports. The first report obtained is the consumption report or consumer analysis. The billing cards are first sorted mechanically into 1,000-gal consumption groups. The cards are then run through the printing tabulator, which provides a count of the number of accounts in each consumption group, the total number of accounts, and the total consumption. These totals are checked against previous similar totals.

Revenue Report

The second report is called the revenue report or analysis. The billing cards are sorted according to type of service. These types include residential, commercial, and industrial and fire service inside the city, in the county, and in the boosted pressure system. From the printing tabulator the figures are obtained for the district for each type of account. The items included are:

1. Type code numbers,
2. Consumption,
3. Net revenue from free city of Louisville accounts,
4. Net revenue from taxable water accounts,
5. Net revenue from all water accounts,
6. Number of water accounts,
7. Number of sewer accounts,
8. Net revenue from sewer accounts.

These columns are totaled manually and the figures checked against results obtained in previous operations.

Accounts Receivable

A copy of the revenue report and all billing cards, or, as they are then called, accounting cards, are turned over to the commercial department bookkeeping force. The total receivable revenue as shown by the revenue report is entered or posted in the bookkeeper's ledger. The amount entered is the exact sum of the individual accounting cards that were used to make the bills. This amount must be accounted for by the bookkeeper until all bills are paid or written off.

TABLE 1

Methods of Payment

Method	Money *per cent*	Accounts *per cent*
Mail	62	46
Cashier's window	23	30
Substations	13	21
Banks	2	3

Large Accounts

The preceding description notes the steps necessary to bill by postcard and to set up for collection the regular bimonthly accounts. The larger monthly accounts are billed in the same manner except that a different rate deck and a paper bill are used. This procedure is necessary because the amounts of consumption and money figures are too large to fit into the regulation postal card. An open-face envelope is used to mail these bills.

Collecting

In Louisville, a customer may pay his bill in cash or by check at the company cashier's window or at a neighborhood substation, or he may send payment through the mail or authorize

his bank to handle it directly. Table 1 shows the popularity of these various methods.

All collections are accompanied by the cashier's stub which was formerly attached to the bill. This stub is identified by the account number on either side and the attachment number on the reverse side. It also shows the gross, discount, and net money figures and totals, as well as the date of the last discount day.

Sorting Stubs

The cashier's stubs that are received by mail with checks, the cash collections at the cashier's window, the substation collections, and the bank collections are sorted by hand into districts for each type of collection. The money totals of the stubs for each type of collection for each district, the total for each district, and the combined total of all collections for each day are obtained by a two-total accumulating adding machine. This accumulated total of all collections must balance with the money received by the cashier by all methods for the day. The cashier's department makes a receipt report by districts each day to the bookkeepers in the accounting department and turns over to them the stubs sorted into districts.

Pulling Accounting Cards

In the accounting department the stubs are sorted manually into account number order and the punched billing or accounting card corresponding to the account number of the receipt stub is pulled from the file by hand. The money figure is checked as the card is pulled to avoid error. These pulled accounting cards are summarized mechanically on the printing tabulator by districts. The individual district totals are checked against the cashier's report of cash receipts for the day. The totals by districts are posted as collections by the bookkeepers each day.

Balancing

Trial balances are taken of each district ledger sheet three times—once just before the current billing is charged against the district, again seventeen days later or after the delinquent discounts have been set up, and again at the time of turning off any unpaid accounts 27 days after the billing date. These trial balances are proved by running all the unpulled or unpaid accounting cards remaining in the file through the printing tabulator. After the discount date, the tabulator is set to pick up only the discount and net amount of each bill. The statement at the end of any month must be balanced before it is passed to the general books of the company.

Delinquent Accounts

Inasmuch as the large discount granted by the Louisville Water Co.—33⅓ per cent—is its best means of collection, it was necessary to adapt the mechanical punch card system to the handling of delinquent accounts. Seventeen days after the billing date of a district, all accounting cards remaining in the receivable file are run through the printing tabulator and a set of delinquent notices is made for each unpaid account. These notices are in the form of paper bills showing only the gross amount due. These sets of notices are broken up into the first, second, and final or turnoff notices. The first notice is mailed on the seventeenth day, the second on the twenty-first day. The final notice is delivered by hand on the twenty-fourth day after billing and

any chronically unpaid accounts are immediately turned off; others are turned off the next day. Any turned-off accounts remaining unpaid are written off as uncollectible after 90 days from the billing date. The delinquent lists are checked each time for any interim payments before sending out the next notice.

An example of how this system of collecting delinquent accounts actually works is best illustrated by citing a single month, August 1950:

45,000 accounts were billed.
1,708 first notices were mailed.
1,060 second notices were mailed.
530 final notices were delivered.
111 accounts were turned off.
45 accounts remained off 27 days after billing.

The net loss from all uncollectible accounts for the month of August amounted to 0.09 per cent of the sales for the month. Many of these charged-off accounts were subsequently collected.

Costs

The International Business Machine equipment is obtained on a rental basis and costs approximately $950 per month. This company handles all maintenance and has been free with instructions and assistance whenever called upon.

A comparison of costs of the new method and the method of machine billing and postcard bills formerly used, corrected for salary increases, is given in Table 2. The installation year, 1949, is omitted from this table as the costs are not comparable. The cost figures given in Table 2 do not tell the whole story. As of Jan. 1, 1949, the water department was faced with the purchase of five new billing machines at a cost of approximately $12,500. There was also a shortage of space to locate additional machines and operators. The billing was falling behind schedule and many errors in bills were constantly appearing. Many overtime hours were expended checking bookkeepers' balances and finding errors in accounting.

TABLE 2

Cost Comparison of Old and New Billing and Accounting Practices

Expense	Old Method 8 Months 1948 (Adjusted) Cost—$	New Method 8 Months 1950 (Actual) Cost—$
Billing and accounting	37,859	37,203
Collecting	15,830	15,529
Commercial Dept.	3,645	13,447
Retirement charges	5,700	166
Total	63,034	66,345
No. of water accounts	83,018	87,780
No. of sewer accounts	71,350	77,019
Total	154,368	164,799
Unit cost per account per month—¢	10.2	10.0

As a result of the new procedure, the department has disposed of a lot of expensive equipment. The same office floor space will be adequate for many years to come. The billing is never behind schedule. Practically no billing errors are made. The ledgers are always in balance and require no overtime work. This increased efficiency and accuracy is being accomplished with five fewer persons in this department.

The Louisville Water Co. is very satisfied with this change in commercial department practices and recommends it highly to other water departments to which it may apply.

Reference

1. Weir, Paul. Machine Billing at Atlanta. Jour. AWWA, **42**:1 (Jan. 1950).

Multiple-Treatment Units for Water Purification

E. H. Aldrich

A paper presented on Sept. 22, 1952, at the Missouri Section Meeting, Jefferson City, Mo., by E. H. Aldrich, Chief Engr., American Water Works Service Co., Philadelphia.

THERE would be no purpose and little reason for the development of new processes and machinery unless utility could be served by producing either a better product, decreased costs, or simplified operation. A new purification plant was designed with all of these purposes in mind when an entirely new water supply was developed for Alexandria, Va., in 1949–50. Almost two years of operation of these works, supported by the results of operation of two similar purification plants recently built for Chattanooga, Tenn., and for the Municipal Authority of Westmoreland County, Pa., have demonstrated the advantages of the new type of plant incorporated in the treatment works.

To assess the advantages and disadvantages of the purification units first developed at Alexandria and subsequently used at Chattanooga and Westmoreland County, a brief description of these three plants in comparison with a conventional filter plant will be of value.

Conventional Filter Plant

A modern, conventional rapid-sand filter plant consists of:

1. Facilities for handling and applying chemicals to the water at predetermined rates.

2. Means for the thorough mixing of these chemicals in the water followed by more gentle agitation in a mixing or coagulating basin to assist in forming the chemical reactions and to produce the floc which collects together the various substances present in the raw water which it is desirable to eliminate.

3. A sedimentation basin in which the velocity of flow is reduced sufficiently to allow the major part of the floc to settle.

4. Filters through which the settled water is passed at controlled rates to remove the last remaining traces of floc.

5. Means for controlling the filtering operations and to provide for the periodic backwashing of the filters.

6. Provisions for feeding chlorine for final disinfection.

7. A covered, filtered-water reservoir to provide storage to take care of peak periods during fluctuations in demand.

Generally, in modern-day practice, the various units in a water purification plant are made of reinforced concrete, normally in separate structures, the tops of which are at or near ground level. Flow between units is through pipelines. There are, of course, numerous variations in arrangement and sizes of units. Occasionally, additional treatment, such as aeration or softening, is required. Each plant must be tailored to provide the character of

treatment and quality of output required.

Mixing and settling basins are usually open except in extremely cold climates. To enable periodic cleaning and necessary repairing, there are generally two or more units in each plant. Throughout most of the country, filters are covered and arranged on each side of a central gallery. The lower level of this gallery contains the piping connections and necessary controls and the upper level the operating equipment. The filters are of a size and number that allow frequent cleaning and backwashing without seriously disturbing the normal output of the plant.

Fig. 1. Westmoreland County Reservoir and Filter Plant

The supply is secured from an impounding reservoir on Beaver Run, formed by an earth embankment dam having a maximum height of 90 ft and impounding 9.2 bil gal from a drainage area of 43.3 sq mi. The four purification units are shown at the lower center of the photograph.

Departure From Conventional Plant

In the plants described herein, the use of multiple purification units represents the essential departure from the conventional filter plant. The units forming the major part of the treatment plant have been termed purification units inasmuch as each of them incorporates most of the processes commonly found in the purification elements of a plant—chemical treatment, mixing and coagulating, settling, and filtering. No unusual treatment processes are used. The raw water is treated with coagulating and other chemicals and receives the usual mixing, coagulating, settling, filtering, pH correcting, and pre- and postchlorinating, that are required in the conventional plant. The structure in which most of these processes take place, however, departs from the usual arrangement and type of construction of the normal filter plant.

The Alexandria treatment plant, already described in detail in the JOURNAL (1), comprises four separate purification units, each an independent mixing, settling, and filter plant of 2.25-mgd capacity.

The units consist of steel tanks that are placed in the open, above ground. The tanks have central mixing compartments 24 ft in diameter, surrounded annularly by settling compartments 76 ft in diameter. The filters are located in an annular compartment around the outside. Water depth in all compartments is 15 ft.

Chemicals are introduced into the raw-water pipeline before the water enters the individual units. A quick mix occurs in the influent pipe. Mixing and flocculation continue more slowly by introducing the treated water tangentially into the mixing compartment, producing a swirling motion and rolling the water around against vertical side baffles. The flocculated water passes to the settling compartment through baffled, horizontal slots near the bottom of the mixing compartment ring. Movement of water through the settling compartment is upward and radially outward, its velocity decreasing throughout its travel until it flows into the filtering compartment over the top of the second annular ring.

The filter around the periphery of the tank is 3 ft wide. A wash water drain gullet 1 ft wide separates the filter and settling compartment. This gullet is filled with concrete which slopes from the back of the unit to the drain outlet to dispose of the wash water. Not only does this drain gullet give structural stability to the unit and particularly to the filter underdrain system, but the two thicknesses of steel plate separated by 12 in. of concrete effectively separate raw and filtered water.

The filter medium consists of 30 in. of sand, of an effective size between 0.45 and 0.50 mm and uniformity coefficient approximately 1.6, resting directly on a bottom of porous carborundum plates supported on steel angles and channels between the inner and outer rings. Two additional units, now being installed, will be equipped with Wheeler bottoms as an experiment. Below the filter bottom is an annular filtered water compartment 3 ft wide by 4 ft deep. Control valves, filter rate controllers, and other appurtenances are located in small valve houses between and serving two purification units. The main pipelines, consisting of the influent, effluent, drain, and wash lines, are of prestressed concrete pipe located below ground level between filter units with connections to individual units of cast-iron pipe. Filter operation is remotely controlled pneumatically from a board in the control building, which is the center of all operations. It is under the control house that filtered water is collected in a 410,000-gal clear well from which high-lift pumps on the main floor pump it into the distribution system.

Westmoreland Plant

The Beaver Run supply of the Municipal Authority of Westmoreland County was developed in 1950–52 to serve water to the major part of Westmoreland County, Pa. It went into service in February 1952. The supply is secured from an impounding reservoir on Beaver Run, formed by an earth embankment dam, having a maximum height of 90 ft and impounding 9.2 bil gal from a drainage area of 43.3 sq mi (Fig. 1).

Below the dam is a low-service pumping station having an installed pumping capacity of 22 mgd, which raises the water to the filter plant. The filter plant is located on a hill overlooking the reservoir and is 112 ft above the reservoir and approximately 2,000 ft from it. The low-service station is not attended but the pumps are remotely controlled from the filter plant.

The only important differences in the construction and arrangement of the purification units at Beaver Run from those at Alexandria are: [1] aeration is provided to assist in removing iron, manganese, and carbon dioxide; [2] the steel units are banked up with earth to a point 4.5 ft below the top of the tanks; and [3] only one valve chamber, instead of two, was used, and it is located in the center of the four units. Otherwise, the construction and operation of the units are essentially the same.

Fig. 2. Chattanooga Filter Plant

The four purification units are shown in the center of the photograph, the old filter plant in the right rear, and the pumping station at the left center.

The filter plant is essentially similar to the plant at Alexandria previously described (1). There are four purification units rated at 2.6 mgd each on the conventional rating basis. At this capacity, detention time in the mixing compartment is 44 min and in the settling compartment, 4 hours and 21 min. The piping and controls at Alexandria were planned to provide for filtering 50 per cent in excess of the rated capacity of the units. At the Beaver Run plant, the piping and controls are large enough to allow 100 per cent excess rating without serious losses.

Chattanooga Plant

The supply for the city water company at Chattanooga, Tenn., is secured from the Tennessee River. The construction program at this plant consisted of a 10-mgd extension to an existing purification plant of 32-mgd capacity (Fig. 2). At the same time, the existing low- and high-service steam pumping equipment was being electrified, but the purification plant exten-

sion was fitted into the existing works, no separate pumping stations were provided, and piping connections were made to existing mains.

With some minor changes, the Chattanooga purification units, constructed in 1951–52 and placed in service in May 1952, are also similar to those in the other plants described. There are four purification units at Chattanooga having a rated capacity of 2.5 mgd, each capable of operation at twice this capacity. The units are located in the open and are not banked with earth as at Westmoreland.

One variation in the construction at Chattanooga was required because of the necessity for a plant output free of turbidity, color, and manganese. This quality of water was required by the substantial textile and allied manufacturing establishments using the water. The purification units were constructed with launder troughs built around the tops of both the mixing basin ring and the settling basin ring in order to collect and bring all of the settled water to one point where it could be treated with lime as it passed to the filters. The author's experience has indicated that the removal of the last traces of manganese can best be effected by applying lime after settling and just before filtration.

The central valve chamber serving the four units was enlarged by adding two additional stories. The floor above the operating valves was provided to house the lime dry-feed machines, additional chlorinating equipment, and manually controlled operating tables. The top floor is used for storage and the feeding of lime.

Inasmuch as the purification units at Chattanooga constituted an addition to an existing plant, chemical storage space and feeding equipment, except for lime and chlorine as described previously, were not needed. Automatic control of hydraulic valves was not provided but the valves controlling each filter are operated from the customary operating tables in the control house overlooking the filter.

Additions to the Chattanooga plant included a steel filtered water reservoir of 1.8-mil gal capacity and a wash water standpipe of 300,000-gal capacity. Main piping connections were of adequate sizes and were laid out to provide for eight additional purification units to be installed whenever the demands require additional capacity.

Operating Results

Although these purification units contained many experimental elements, and alterations continue to be made in some minor features, after two years of operation it can be said that they have successfully met the requirements of design and operation.

Each of the plants described herein has its own individual problems of treatment. In the Alexandria plant, the water to be treated is extremely variable in color, turbidity, and manganese content. Color combined with manganese and low alkalinity water is the principal treatment problem. The Westmoreland plant treats a water containing considerable acid mine drainage, iron, and manganese. To date, no alum as coagulant has been used. Aeration, lime, and chlorine have been the chief treatment chemicals. At Chattanooga, alum is the coagulant and lime is used on top of the filters to aid in complete elimination of manganese.

Chemical costs at Alexandria have varied between \$3.69 and \$10.22 per million gallons treated with an average of approximately \$8.00. During the

six months of operation at Westmoreland, chemical cost has averaged $4.35 per million gallons. No separate costs for chemicals can be determined for the new Chattanooga plant as it is combined with the existing plant, but the chemical cost for the entire plant during the past three months has averaged $3.12 per million gallons, a very low figure.

Water for washing filters varies among the plants from 1.5 per cent of output at Westmoreland to 2.7 per cent at Alexandria. In addition, approximately an equal amount is used to fill up the filter compartment after washing in order not to destroy the floc as it passes into the filter from the settling compartment.

At both Alexandria and Westmoreland, the labor force needed to operate the filter plant and the high-lift pumping station, located in the control building at both plants, consists of eight men—four shift men, one relief man, one maintenance man, a chemist, and a chief engineer. In addition, at Westmoreland, this force operates the low-service pumping station by remote control. In Alexandria, where some hydraulic power is also generated in the low-service station, four shift men are also employed, as this station is remote from the filter plant. No additional labor was required at Chattanooga.

Each settling and mixing compartment of the purification units is cleaned at intervals of three to four months. It takes four men approximately 1½ hours to accomplish the cleaning which, including time for emptying and refilling, means a unit is out of service for approximately 6 hours. As a maximum, the cost of cleaning the settling compartment has not been more than $50 per year per unit. At all of the plants described, conditions during the summer of 1952 have necessitated operation for substantial periods at rates from 30 to 50 per cent in excess of nominal capacity.

The operation of these units presents some differences from operation in a conventional plant. Inasmuch as the settled water passes directly from the mixing compartment to the settling compartment and then to the filters without floc disturbance, it is felt that better treatment results. There is substantially no loss of head from the time the water enters the mixing basin until it passes through the filter except the loss of head in passing through the filter sand and a negligible loss in passing through the underdrain system. When washing at a 24-in. per minute rise rate, the loss through the filters at Alexandria is approximately 33 in. of which only 3 in. occurs in the porous plate underdrain. At Chattanooga, the flow line of the new units is approximately 15 ft below that of the old settling basins and the effluent goes to the same elevation, indicating the savings in head which could have been secured if all of the plant units were of the new construction.

Inasmuch as the head of water on the sand bed in normal operation is approximately 8 ft, the usual negative head below and in the filter bed is practically eliminated. The filters have been operated up to approximately 12 ft of loss but at the present, in normal operation, the filters are washed at a convenient time when the loss is between 8 and 10 ft.

Construction Costs

One of the major objectives of the new purification unit design was to reduce the capital cost of the plant. Recent experience has shown that the capital costs of conventional plants of

approximately the same size as those described herein have been in excess of $100,000 per million gallons per day capacity and range to more than $200,000.

Many elements of the plants described herein were constructed large enough to serve a plant three times the capacity of the present installations. This expansion is possible by making few additions to plant and equipment other than the additional purification units and the small amount of connecting piping, valves, and controls to serve them.

At the conventional rating of 2 gpm per square foot of filter, the costs of these plants have been between $70,000 and $82,000 per million gallons per day capacity. The Alexandria plant, not including engineering, land, or the raw water pumping station, dam, and connecting raw water line averaged $79,000 per million gallons per day capacity. The two units now being added, including additional pumping equipment, will cost less than $40,000 per million gallons per day capacity, making the average cost of the complete filter plant of 13.5-mgd capacity approximately $65,000 per million gallons per day capacity.

TABLE 1

Ages of Various Filter Units

No. of Units	Type	Avg. Age *yr*	Oldest Unit—*yr*
228	Steel	41.6	63
305	Concrete	24.9	46
99	Wood	33.3	53

Objections and Comments

A number of objections have been raised and comments made on the type of construction, materials, and details of the purification units described herein. These objections and discussion on them follow:

1. *Maintenance cost of steel higher than concrete.* Steel tanks, to be preserved, must be painted periodically, a relatively simple, inexpensive, and standard operation. That substantial, difficult, and frequently unsuccessful maintenance jobs are required on concrete mixing, settling, and filter basins, from time to time, should not be overlooked. The new purification units described herein can be built satisfactorily of prestressed or reinforced concrete at somewhat added cost.

2. *Structural life of steel shorter than concrete.* Few facts are available to substantiate the statement that concrete structures will outlast properly maintained steel structures. Information on the ages of filter units in plants operated by the company with which the author is associated is given in Table 1. At the beginning of 1951, 632 filter units, having a nominal capacity of 435 mgd, in 61 different plants, were in operation. The author's experience has indicated that steel filters will have a life approaching 50 years. Thus, at a rate of 6 per cent for interest and depreciation, a saving of 6 per cent in first cost of a structure will entirely amortize the full cost of such a structure in 50 years. Stated in another way, a $20,000 per million gallons per day saving in filter plant construction in 48 years at 6 per cent interest will become $320,000, four times the indicated total cost of these purification units. Such substantial savings should not be dismissed lightly.

3. *Open basins suitable only for mild climates.* The author's operations indicate that open settling basins are adequate for all parts of the United States except the very northerly part. Ice

formation in open basins sometimes requires breaking up and sometimes partial removal in the coldest periods. The situation is improved by adding filters on the outside of the settling basins as any usual ice formation in the filter is easily broken up in the washing operation.

The movement of water in the circular filter tends to decrease ice formation. Where necessary, agitation around the edge can easily be provided. Embankments around the units as in Westmoreland will protect the lower filter area and, in extremely cold areas, covers can be provided. Modifications of the design will adequately protect the unit from freezing. In the units described herein, covers or any unusual protective measures were not considered necessary.

4. *Small units uneconomical.* The sizes of units can be varied almost at will. Economical construction is possible using both large and small units. Units of 10-mgd capacity each are under consideration and there is no indication that units of 0.5 mgd or less cannot be built and operated economically. Units of the smaller sizes should have a larger field of usefulness as it is in the small communities that the capital costs of filtration become almost prohibitive and where economy is essential.

5. *No advantages in circular tanks over rectangular ones.* In the author's judgment, there are certain advantages in the circular settling compartment as a more uniform flow is created in the basin and over the settling-filter compartment dividing wall. Because of the continuously increasing cross-sectional and surface area, the velocity of flow is constantly decreasing and floc formation and settling are improved. One of the major advantages of the circular type of basin, whether it be constructed of steel, concrete, wood, or other material, is the structurally simple type of design. From internal pressure, all rings are in tension. From outside pressure of earth, the rings are in compression. In the conventional rectangular concrete basin, there are compression, tension, bending, torsional, and secondary stresses difficult to analyze accurately; these stresses result in overdesign which tends to produce excessive costs. From the design standpoint, it is possible to design a steel tank in a few hours that would take days to design in reinforced concrete. In structures such as filter plants, design becomes more complex and the time required for design is considerably extended.

6. *Conventional design simpler to operate.* After two years of operation at Alexandria, the author has concluded that the operation is simple, effective, and economical. Few conventional filter and pumping plants can be operated by one man per shift.

7. *No provision for visual inspection of washing operation.* The walkways around the top of the filters give full opportunity for visual inspection if desired. In addition, a pushbutton on the walkway at the filter allows the operator to prolong washing as he desires.

8. *No provision for periodic drawdown of filters to inspect sand.* The filters can be drawn down as desired and the entire exposed area of the filter bed can be examined with ease, particularly in full daylight.

9. *Tangential mixing not always satisfactory.* It is true that tangential mixing may not always be advisable. Each installation should be tailored to

the particular requirements. Mechanical or other types of mixing equipment can be used.

10. *Sludge collection equipment necessary for proper operation.* In some installations, sludge collection and disposal equipment may be highly desirable. The layout and shape of the purification unit lends itself readily to the use of sludge removal equipment. It is also easily adaptable to softening, including recarbonation, to the use of clarifying and flocculating mechanisms, and to the use of upward flow and suspended bed type of sedimentation.

11. *More chemical supervision needed than for conventional design.* The author's operating experience tends to support the opposite conclusion.

12. *Not necessary to place filters annularly to eliminate building.* The elimination of the building is only one element of the economy in these purification units, as pointed out herein.

13. *Control chambers not easily accessible during inclement weather.* The control or valve chambers are not inaccessible but it is necessary to go outdoors to reach them. Once inside the valve chambers, the equipment is readily accessible to observation and work—much more so than is the conventional pipe gallery. Further, the ever-present leakage in piping and valves and the sweating of pipe during hot periods are sufficiently decreased that they cause no damage and little inconvenience, and the customary eyesore is eliminated.

14. *Piping layout more expensive.* The author has found the new piping layout to be less expensive. Most of the piping, especially in the large sizes, is of prestressed concrete pipe buried in the ground between units or covered with gravel in the valve houses. Only the tops of the control valves and filter effluent controllers are exposed. Maintenance is reduced and more easily accomplished. Flanged piping has been reduced to a minimum. Once having determined the layout and installed the first units, the additions to plant piping are simple and economical.

15. *Carborundum plate underdrains not satisfactory.* In some installations carborundum plate underdrains have not been satisfactory and in others they have proved to be very satisfactory. Wheeler or Leopold bottoms, perforated plates, or other types of underdrain systems, however, can easily be installed.

16. *Automatic controls not necessary or desirable.* Automatic controls are not necessary. Labor saving and more uniform operation are the major purposes of automatic equipment. They add to the cost and probably will require some maintenance. The automatic filter control equipment at Alexandria, however, has been highly successful, has required substantially no maintenance, and has caused very little trouble in two years of operation.

Advantages

Without elaboration, some of the advantages which have been cited by disinterested parties include:

1. Steel construction cheaper than concrete.
2. Annular filters satisfactory if properly designed.
3. Principle of multiple units sound and necessary.
4. Design economical, compact, and flexible.
5. Minimum floc disintegration due to turbulence.
6. Air binding eliminated by depth of water over filters.

7. Low percentage of wash water used.

8. First cost lower than conventional plant.

9. Operation as upflow unit possible if properly proportioned.

10. Modification possible to include practically all of the refinements of mixing and settling tanks now in popular demand; filter surface wash, even air wash, easily and economically installed.

Conclusion

The substantially lower construction costs, the low operating costs, and the flexibility and ease of operation, in the author's judgment, so far outweigh the relatively few and minor disadvantages which have been found in these purification units that the author's organization has decided to proceed with the installation of similar units in many of its plants.

A recent experience in trying to build an addition to an existing plant at Ashtabula, Ohio, illustrates the difficulty of getting reasonable bids for filter plant construction at present-day costs. The low bid at Ashtabula for the first element of a 4-mgd extension to the filter plant, which included only the excavation and concrete work for the settling basin and did not include pipe work or reinforcing steel, was $243,000. The estimated cost of the entire addition, including filter plant, clear well, and piping connections, at the indicated unit prices, was nearly $700,000, a unit cost of $175,000 per million gallons per day capacity. Plans were then revised to put in two 2-mgd steel units, a control house, and two filtered water tanks at an estimated cost of $350,000, approximately half of the indicated cost of the conventional plant.

In the American Water Works Service Co. system, three more plants will soon install units similar to those at Alexandria. In these days of soaring prices, it behooves water utilities to seek every means available to effect economies in construction and operation.

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Installation and Performance of Radial Collector Wells in Ohio River Gravels

By H. K. Gidley

A paper presented on Oct. 3, 1952, at the West Virginia Section Meeting, Parkersburg, W.Va., by H. K. Gidley, Director, Div. of San. Eng., West Virginia Dept. of Health, Charleston, W.Va.

THE extraction of water by radial, or horizontal, collector wells * from the unconsolidated alluvial deposits in the Ohio River valley has become increasingly important in West Virginia during the past decade. A total of thirteen wells have been installed in the state since 1942 (not including one now under construction), and additional installations may result from recent investigations. The general locations of the wells are shown in Fig. 1.

A number of communities along the Ohio River have attempted to develop water supplies from the widely distributed gravel deposits by methods other than the customary vertical well (1). In 1899, the city of Chester, W.Va., installed an offshore filter crib in the bed of the Ohio River. A wooden crib 80 ft long, 20 ft wide, and 6 ft deep was lowered into a 12-ft hole in the river bed. The crib rested on a pipe collecting grid connected to a pump well. The crib was backfilled with river gravel and the remaining 6 ft of hole was backfilled with a mixture of sand and gravel. The crib has been in continuous use for 53 years and is pumped at a rate of 0.5 mgd. The water secured from the crib is clear, safe, and palatable, and chlorination as an added safety measure is the only treatment. The crib is apparently recharged mostly by lateral flow from the gravel deposits beneath the river rather than by direct vertical filtration.

In 1922 New Martinsville, W.Va., constructed a 20-ft diameter, 63-ft deep concrete caisson on the river bank. The open bottom of the caisson terminated in a water-bearing sand and gravel formation. Originally all of the water entered through the unsealed bottom, but later, to increase well yield, short sections of perforated pipe were driven horizontally through openings cut in the caisson wall. This was undoubtedly the first radial collector well in West Virginia. The New Martinsville well is in use today and the yield is 0.5 mgd.

Construction

A radial collector well is constructed by lowering a cylindrical concrete caisson into an unconsolidated water-bearing formation, sealing the bottom with a concrete plug, and jacking perforated collecting pipes horizontally into the aquifer. As the lateral collectors are jacked into position, the fines in the aquifer are removed, thus developing a natural gravel screen around the col-

* The thirteen wells discussed in this paper were installed by Ranney Method Water Supplies, Inc., Columbus, Ohio.

TABLE 1

Summary of Data on Radial Collector Wells in West Virginia

Well	Year Constructed	Well Diam. *ft*	Depth Below Surface* *ft*	Static Water Depth (River at Pool) *ft*	Total Length Collector Lines *ft*	Initial Yield† *mgd*	Yield in 1952‡ *mgd*	Normal Pumping Rate‡ *mgd*
W.Va. Ordnance Works								
Well No. 1	1942	13	73	35	804	2.5		
Well No. 2	1942	13	66	36	899	2.8		
Well No. 3	1942	13	61	34	1,081	2.2		
Well No. 4	1942	13	62	33	1,007	1.8		
Well No. 5	1942	13	59	31	1,001	2.1		
Well No. 6	1942	13	59	33	1,219	2.1		
du Pont								
Well No. 1	1947	13	92	30	1,259	4.5§	3.6	2.4
Parkersburg								
Well No. 1	1946	13	60	16	800	3.5	2.0	2.0
Well No. 2	1949	13	56	17	800	2.5	2.0	1.5
Well No. 3	1949	13	54	18	800	4.0	3.5	2.25
Calco								
Well No. 1	1947	13	36	24	1,008	4.0	3.2	2.2
Well No. 2	1948	13	51	25	1,052‖	1.75	1.75#	1.75
Well No. 3	1952	13	54	31	844**	4.25	4.25	2.6

* Depth to concrete plug. Collector lines 2–3 ft above plug.
† Yields shown for W. Va. Ordnance Works wells represent minimum yields computed for 45 F.
‡ Operation of West Virginia Ordnance Works wells ceased in 1945.
§ Maximum capacity not determined, but in excess of 4.5 mgd.
‖ Includes 51-ft collector added in 1951.
Initial yield restored by adding 51-ft collector in 1951.
** Length after closing off an 89-ft defective lateral.

lector. Five to eight lateral collectors are generally used, with individual lengths normally varying between 100 and 250 ft, although longer and shorter ones may be installed. The laterals may fan out in a semicircle or in a full circle like the spokes in a wheel. The caisson projects above the ground, if necessary, to reach a level above flood stage, and the bottom rests on shale or bedrock. Vertical-turbine pumping units are used to pump the water which flows into the caisson through the lateral collectors. Pertinent data on the thirteen wells are given in Table 1. Following are general descriptions of these installations.

West Virginia Ordnance Works Wells. A large TNT plant for World War II was hurriedly constructed near Point Pleasant, W.Va., in 1942. The water supply initially planned for the plant was to be provided by 6 radial collector wells. The total minimum yield of the six units was approximately one-third of the predicted yield, and a filter plant to treat river water was subsequently constructed to furnish the needed flow. A very thorough hydrologic study of the two well fields was made at the West Virginia Ordnance Works following the failure of the collector wells to produce as expected (*2*). The plant ceased operation in 1945 and the wells have been out of service since that date.

Parkersburg Water Works Wells. In 1928 Parkersburg, W.Va., developed a well field consisting of eighteen vertical wells. The high initial pro-

duction of these wells gradually deteriorated as a result of overpumping, and in 1946, when a water shortage was impending, the first collector well was installed. Subsequently two other wells were added. A manganese problem, which will be discussed later in this paper, developed when the second and third wells were installed.

du Pont Well. This well serves the Washington, W.Va., works of E. I. du Pont de Nemours & Co., Inc., and was installed in 1947 when this chemical plant was constructed. This well had the highest initial yield of the thirteen wells discussed herein.

Fig. 1. Location of Radial Collector Wells in West Virginia

Calco Wells. These wells serve a large and growing chemical plant operated by the Calco Chemical Div., American Cyanamid Co., at Willow Island, W.Va. One well was installed in 1947 and two additional wells were provided in 1948 and 1952 as plant expansion increased water needs. The well installed in 1952 is located on Lower Brothers Island in the Ohio River, whereas all of the other 12 wells discussed are located on shore.

Geology

Geologists (*2*) state:

Preceding the Pleistocene glaciation of northeastern North America, and during intervals between ice advances, the ancestral Ohio River carved out a deep and relatively flat-floored valley. The ice barrier impounded some of the streams that drained toward the north and diverted additional amounts of water southward through the ancestral Ohio River which resulted in widening and deepening the rock valley of the river. The large, rapidly flowing river formed by water from the melting ice carried down huge amounts of rock debris and deposited it in the valley. Following the disappearance of the ice sheet, the Ohio River assumed a more normal flow and began to erode the unconsolidated valley fill. At successively lower levels flat flood plains were developed which form the present terraces.

There is, of course, considerable variation in the deposits from which the radial collector wells extract water, but the well logs given in Fig. 2 appear to be typical of the formation.

Well Yield

The initial yield of the wells varied from 1.75 mgd to more than 4.5 mgd (Table 1). The well outputs are substantially increased during high stages of the Ohio River. The Ohio River is developed for navigation by a series of locks and dams, and the navigation pool elevations are fixed by these dams. The static water levels in the wells follow the level of the river although there may be some lag. Inasmuch as the river is at pool stage much of the time, the dependable yield of a well is fixed by the pool stage. On one

occasion a critical water shortage developed at Parkersburg when the normal pool elevation was temporarily lowered to prevent ice damage to the dam wickets, thus cutting the yield of the collector well.

Before the installation of a radial collector well, a hydrologic study is made. The permeability of the aquifer is determined from data obtained by pumping small-diameter test wells. Predicted yields of the earlier wells were somewhat optimistic. The six wells at the West Virginia Ordnance Works produced approximately 10,000 gpm instead of the expected 33,000 gpm. The predicted yield of Calco Well No. 1 was 5.6 mgd and the developed yield was approximately 4.0 mgd. The local variation in an aquifer may be considerable. Calco Well No. 2 is located adjacent to Well No. 1 (approximately ½ mile away), and each was expected to produce the same amount of water, but the yield of Calco No. 2 was less than half that of No. 1. The developed yields of Parkersburg Wells No. 1 and 2 were approximately 12 per cent less than expected. As the well development company's hydrologists gained experience, the computed yields have become more accurate. There is good agreement between the predicted and developed yield of Calco Well No. 3. The computed yield of Parkersburg Well No. 3 was 4.5 mgd, but local conditions led the hydrologists to introduce a 40 per cent safety factor and, consequently, the predicted yield was 2.7 mgd. Actually the developed yield was approximately 4.0 mgd. The yield of the du Pont well was also in excess of the guaranteed yield.

Recharge of the alluvial aquifers occurs through the percolation of rainfall into the ground and by infiltration from the river. Usually a substantial part of the recharge comes directly from the river although, in a few installations, direct recharge from the river does not seem to be the main factor. According to the hydrologists (2), West Virginia Ordnance Works Well No. 1 received very little of its recharge directly from the river (only 300 ft distant), and it was suggested that recharge of the aquifer occurred more than 2,800 ft from the well location.

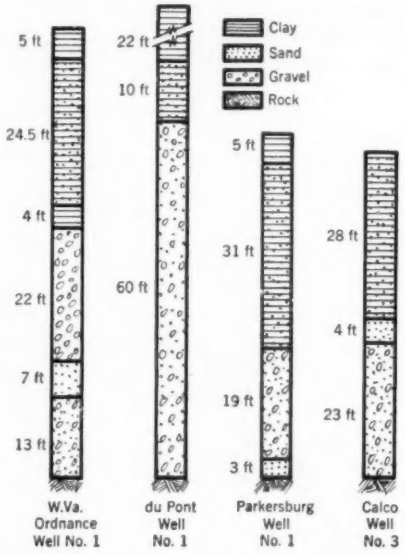

Fig. 2. Typical Soil Formations Penetrated by Wells

There is considerable variation in the deposits from which the collector wells extract water.

The du Pont well, which has been pumped at a relatively low rate thus far, is apparently not dependent upon direct recharge from the river inasmuch as the chemical makeup of the

TABLE 2

Mineral Characteristics of Water From Five Collector Wells

Mineral Characteristic	Well*						
	Parkersburg No. 1 (8/27/52)	Parkersburg No. 2 (8/27/52)	Parkersburg No. 3 (8/27/52)	du Pont No. 1 (8/12/46)	du Pont No. 1 (10/10/47)	du Pont No. 1 (1/16/48)	Calco No. 1 (5/52)
Alkalinity (as $CaCo_3$)—*ppm*	78	88	115	212	212	197	61
Hardness (as $CaCo_3$)—*ppm*	169	233	213	227	170	172	133
Chloride (Cl)—*ppm*	31	56	47	2	6		14
Calcium (Ca)—*ppm*	49	62	60				
Magnesium (Mg)—*ppm*	12	20	16				20
Silica (SiO_2)—*ppm*							12
Iron (Fe)—*ppm*	0.8	1.5	0.7	0.02	0.04	0.008	0.07
Manganese (Mn)—*ppm*	0.1	1.8	1.8	0.01		0.001	
pH	7.2	7.2	7.3	7.8	7.3	8.2	

* The dates in parentheses indicate the time the analysis was made.

well water is entirely different from that of the river (Table 2). The persistent manganese content of Parkersburg Wells No. 2 and 3 indicates a strong influence of ground water (Table 2).

After making a thorough study of the two well fields in which the six wells at the West Virginia Ordnance Works were located, the hydrologists concluded (2):

> The complexity of the alluvial deposits in the water-bearing formation and the erratic distribution of areas through which river recharge occurs indicate that factors of yield and sources of water determined at one site cannot be applied elsewhere, even within the same well field. This investigation has shown that wells located along a river do not necessarily obtain large quantities of water by infiltration from the river, and that it is advisable to test each proposed well site for effective river contact.

It is apparent from Fig. 3 that Calco Well No. 1 and the Parkersburg wells receive a considerable percentage of supply from direct river recharge. An examination of the hardness fluctuations shows that approximately eight weeks is required for river infiltration to reach Calco Well No. 1. Figure 4, copied from a hydrographic report (2), clearly illustrates the zone of influence of a radial collector well on the water table.

Of the several wells now in operation that have been pumped 3 or more years, all have shown some reduction in capacity, according to information furnished the author by the well owners. This information has been tabulated in Table 1. The capacity of Parkersburg Well No. 1 has declined from 3.5 to 2.0 mgd in a 6-year period. The capacities of the other Parkersburg wells, the two older Calco wells, and the du Pont well have also measurably declined. The capacity of Calco Well No. 2 was restored in 1951 by adding another lateral.

Whether the loss in capacity of these wells is due to incrustation or the movement of fines toward the collector lines has not been determined. The problem is being studied at Parkersburg. Probably the well capacities can be restored by redevelopment.

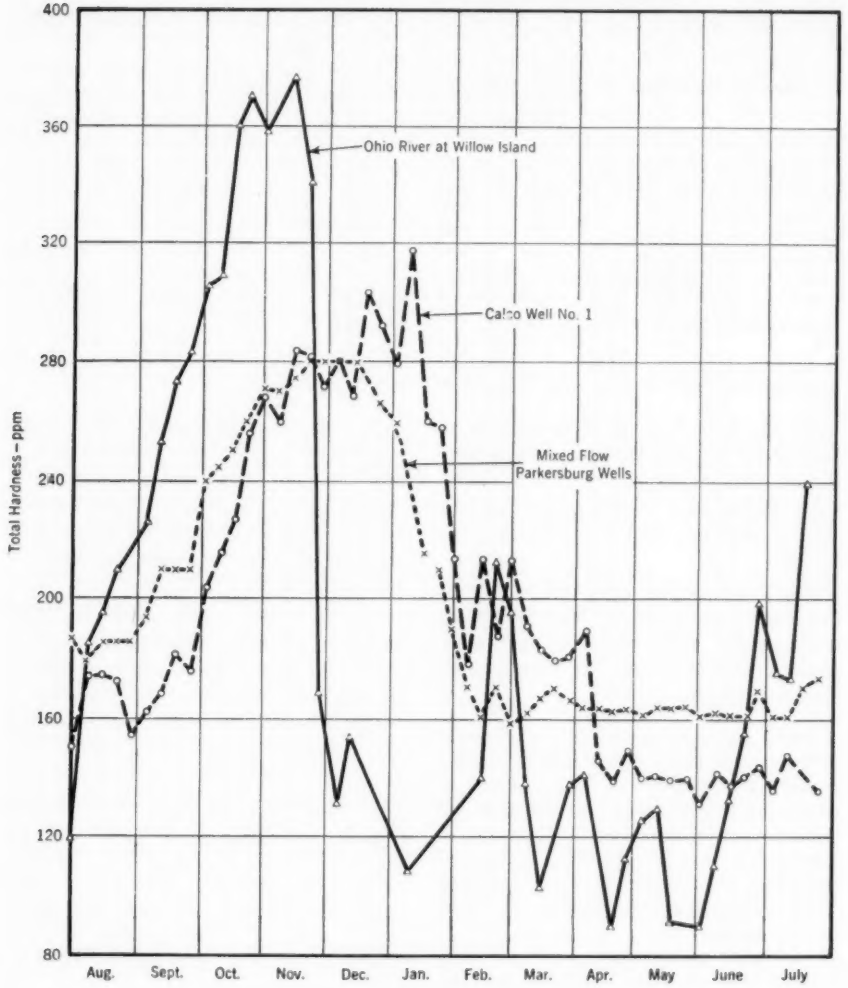

Fig. 3. Hardness of Collector Wells and Ohio River

Calco Well No. 1 and the Parkersburg wells receive a large percentage of their supply from direct river recharge. The analyses were made from August to December 1951 and January to July 1952. The curves are based on weekly tests, some of which were missing.

TABLE 3

*Hardness and Alkalinity of Well Waters Compared to Ohio River Water**

Date of Analysis	Alkalinity—*ppm*				Hardness—*ppm*			
	Ohio River†	Calco Well No. 1	Calco Well No. 2	Parkersburg Wells No. 1, 2, 3 (Mixed)	Ohio River	Calco Well No. 1	Calco Well No. 2	Parkersburg Wells No. 1, 2, 3 (Mixed)
Aug. 1951	13	57	53	74	197	165	169	184
Sept.	5	65	61	78	259	172	167	206
Oct.	8	53	56	72	341	233	198	253
Nov.	13			72	295	275	249	276
Dec.	14	55	55	72	140	286	245	272
Jan. 1952		57	55	68		279	273	215
Feb.	15	51	53	54	177	199	231	165
Mar.	16	51	58	64	144	190	211	166
Apr.	14	61	62	62	115	157	165	163
May	18	61	56	60	116	140	138	164
June	20	62	48	62	138	139	132	164
July	21	60	52	63	197	140	131	169
Avg.	14	57	55	67	191	182	192	200

* The monthly averages are based on weekly tests.
† Analyses made at Willow Island, W.Va.

Physical and Chemical Characteristics

The radial collector well is regarded favorably by industrial users because of the relatively low and unvarying temperature of the water. Yearly temperature variations of only a few degrees are reported (Fig. 5). The well waters are uniformly free of turbidity and have an excellent bacteriological quality. Although the Ohio River is notorious for its foul taste and odor characteristics, the collector well waters are free of this nuisance.

There is considerable variation in the chemical makeup of the well waters (Table 2). Water from the du Pont well is entirely different from the waters of the Parkersburg and Calco wells. As previously noted, little of the water in the du Pont well comes from direct river recharge.

A comparison of the average monthly alkalinity (methyl orange) and hardness of the Ohio River and five wells for twelve consecutive months ending with July 1952 is given in Table 3. The average yearly hardness of river and wells is approximately the same. The bicarbonate ion content of the well waters is much higher than that of the river, reflecting the influence of normal ground water. A method of computing the percentage of river recharge based on mineral characteristics has been suggested by Jefferds (3).

Manganese Problem

The use of Parkersburg Wells No. 2 and 3 created a serious and unexpected manganese problem. Although the presence of iron in the well field was noted during many years of operation of the old vertical wells, an objectionable amount of manganese had not been anticipated. It was predicted that continuous pumping would soon replace most of the normal ground water with river infiltration and, as a result, the manganese content would

cease to be a serious problem. After three years of practically continuous pumping, the manganese content remains high, particularly during dry weather (Table 2).

Fortunately, treatment facilities which could be quickly adapted to curing the manganese problem were available. In 1938 Parkersburg installed a 4.0-mgd, iron-removal and softening plant to treat the water from the vertical wells. The plant consists of a spray aerator unit, 30-min reaction basin, two 1.0-mgd gravity sand filter units, two 1.0-mgd gravity zeolite units, and a clear well.

The zeolite units had not been used for softening for some years before 1949 when the manganese problem developed, but had been used as straight filters for iron removal.

The use of water from Parkersburg Wells No. 2 and 3 in the system resulted in serious consumer complaint because of the manganese. Limited existing plant facilities prevented orthodox precipitation of manganese by lime treatment at a high pH or by superchlorination. After a period of experimentation and trial, a successful method of treatment which has been used during the past three years was developed.

During July 1952 the mixed flow from Parkersburg Wells No. 1–3 contained an average of 1.8 ppm of manganese, a maximum of 2.0 ppm, and a minimum of 1.6 ppm. Following aeration the water is treated with 12 ppm of hydrated lime, and after a 30-min detention in a small reaction basin, the water is applied to the filters. In July 1952 the filtered water contained an average manganese content of 0.45 ppm. A heavy manganese deposit has been built up on the sand grains in

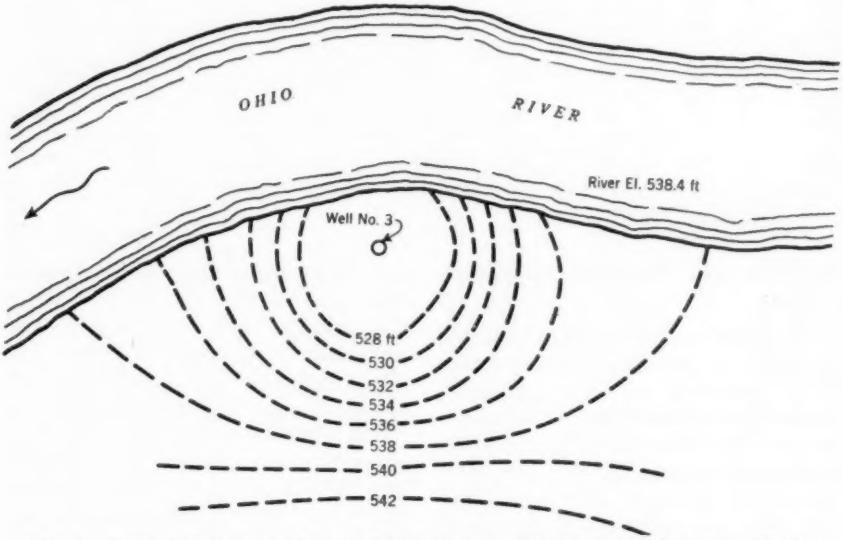

Fig. 4. Ground Water Level During Pumping of West Virginia Ordnance Works Well No. 3

The map shows the zone of influence of a radial collector well on the water table.

the filters and contact action with the deposited mineral undoubtedly accounts for much of the removal.

Although the manganese content is substantially reduced by filtration, the amount remaining is excessive and sodium hexametaphosphate * is applied to the filtered water to hold the remaining manganese in solution and reduce consumer complaints. An average dosage of 1.8 ppm of sodium hexametaphosphate is used with good results.

Cost of Collector Wells

The costs of several collector wells constructed since 1946 are given in Table 4. Based on present prices, a cost of $20,000 to $40,000 per million gallons per day capacity can be expected for the well alone.

TABLE 4

Costs of Several Radial Collector Wells Installed in West Virginia

Well	Date Installed	Cost* $	Cost $/mgd
Parkersburg No. 1	1946	68,000	19,430
Parkersburg No. 2	1949	75,000	30,000
Parkersburg No. 3	1949	75,000	18,750
Calco No. 1	1947	70,000	17,500
Calco No. 2	1948	70,000	40,000
Calco No. 3	1952	94,000	22,100

* Cost of well when installed. Does not include pumping and other equipment.

Position of Laterals

An interesting development occurred during the construction of Calco Well No. 3. During the installation of the lateral collector lines, sinkholes appeared at the surface over two of the lines. This occurrence led to speculation on the position of the laterals in the aquifer. John Ludden, power superintendent at the Calco works, has described the ingenious technique used to determine the profile of the laterals after installation: A small-diameter pipe, with outer end capped, was inserted in the lateral until the capped end was at the desired distance, either all the way or at an intermediate point. The cap prevented the water flowing in the lateral from entering the pipe. A small-diameter rubber tube was next inserted in the capped pipe until the end of the tube reached the cap. A vertical sight glass was connected to the end of the tube in the well. Water was poured in the open end of the sight glass until a maximum level was reached in the sight glass. This maximum level indicated the elevation of the end of the capped pipe since the rubber tube would fill and all additional water added to the sight glass would run out of the open end of the tube and return to the well through the capped pipe. By measuring the verti-

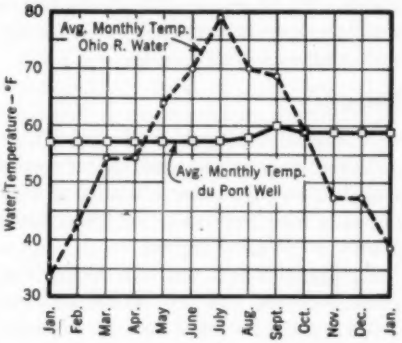

Fig. 5. Average Monthly Temperatures of Ohio River and du Pont Well No. 1

The yearly temperatures of radial collector wells vary only a few degrees. The temperatures were taken from January 1948 to January 1949. The average pumping rate during this period varied between a low of 0.60 mgd in March 1948 to a high of 1.24 mgd in December 1948.

* Calgon, a product of Calgon, Inc., Pittsburgh, Pa., is used.

cal distance between the center of the lateral and the water level in the tube, it was possible to determine the elevation of the end of the tube in the lateral. It was necessary to lower the water level in the well by pumping during the measuring operation.

All of the eight lateral collectors in Calco Well No. 3 were deflected upward in varying amounts in driving. One lateral was deflected 8 ft 10 in. in 54 ft; another, 2 ft 1 in. in 64 ft; and a third, 11 ft 2 in. in 145 ft. One lateral, 89 ft in length, developed a sinkhole approximately 45 ft from the well and was abandoned.

Summary

1. Radial collector wells have been successfully used for the extraction of water from the unconsolidated alluvial deposits which occur in the Ohio River Valley in West Virginia.

2. The thirteen wells in West Virginia indicate that an initial yield of 2.0–4.5 mgd per well can be expected when the river is at pool stage. Reasonably accurate predictions of yield at specific locations can be determined in advance by hydrologic studies. Considerable local variation in an aquifer is not unusual, and each well must be considered as an individual unit.

3. The yield of some radial collector wells may measurably decrease in a 3–6-year period. A longer record is needed to determine the effective life of these wells. Current studies are being made to determine the cause of loss of capacity. It seems probable that well capacity can be restored by redevelopment.

4. Water obtained from collector wells is clear, has excellent bacterial quality, is free of taste and odor, and has a fairly uniform temperature.

5. Water from a well receiving most of its recharge by direct river infiltration will have an average hardness comparable with that of the river, but the carbonate hardness of the well water will be appreciably higher. In some locations and at low rates of pumping, collector wells may not be extensively recharged by direct river infiltration, and the chemical makeup of the water will be representative of normal ground water in that location. If an objectionable amount of iron or manganese is normally found in the aquifer, recharge from the river may not be sufficient to eliminate the mineral problem by dilution.

6. Based on current costs, a radial collector well alone will cost approximately $20,000 to $40,000 per million gallons per day capacity, depending on the yield of the particular well.

Acknowledgment

The author is indebted to R. C. Bundy, Works Engr., Washington Works, E. I. du Pont de Nemours & Co., Inc., for Fig. 5 and other data; to John Ludden, Power Supt., Willow Island Plant, Calco Chemical Div., American Cyanamid Co., for test data used in Fig. 4, and other data on the Calco wells; and to Cecil C. Coffield, City Water Commissioner, Parkersburg, W.Va., and Roy Daniels, Plant Chemist, Parkersburg Water Works, for data on the Parkersburg wells.

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Taste and Odor Problems During Spring Runoff

Panel Discussion

A panel discussion presented on May 6, 1952, at the Annual Conference, Kansas City, Mo.

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THE Missouri, longest of North American rivers, extends 2,550 miles from its source near Three Forks, Mont., to its confluence with the Mississippi River at a point just above St. Louis, Mo. This river drains one-sixth of the United States, approximately 521,000 sq miles. The geographic features of this area, the Missouri River Basin, vary greatly. Along the western boundary some of States may be found, whereas vast stretches of flat terrain lie in the central Great Plains region. The mountthe highest mountains in the United tain slopes and areas adjacent to the streams abound profusely with tree growths. The land lying west of the Missouri River is known as the "shortgrass country" and that east of the river as the "long-grass country."

Many water works experts, chemists, and sanitary engineers have had varied experiences with the moods of the Missouri, or "Big Muddy." These men have had to take out the mud and silt, combat algae growths, and remove tastes and odors so that the people in their communities would be supplied with safe, palatable water.

In 1946 the U.S. Army Corps of Engineers made a survey of problems confronting water works engineers of cities along the Missouri River. The survey indicated general agreement that tastes and odors are the most difficult problems in treating Missouri River water for domestic use.

This survey sought primarily to determine the effects of both low water flow and flood conditions on the quality of raw river water. It was found that at low flow the water is harder and carries a heavier concentration of dissolved materials. Frequently at low stages there are more algae, resulting in disagreeable tastes and odors which are difficult to remove. Flood flow increases the silt load, causing higher turbidities and greater concentration of organic matter with objectionable tastes and odors.

Source of Tastes and Odors

The author believes that, in the Missouri River Basin above Omaha, tastes and odors are derived from four major sources:

1. Noxious and bothersome algae slime, which causes foul odors, on banks and beds of tributaries feeding into the Missouri River.
2. Offal and decaying vegetation deposited on the stream beds during low-flow periods or in the winter season.
3. Sewage and untreated discharges from municipalities along the river.
4. Silt, including agricultural and natural organic wastes, during flood flow.

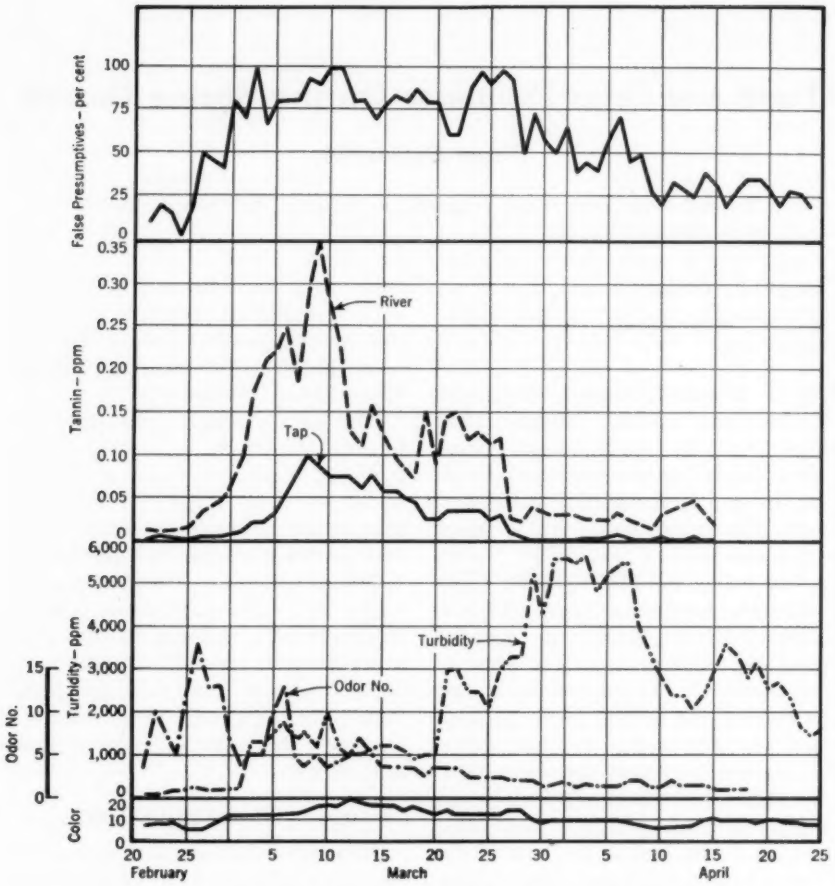

Fig. 1. Raw Water Characteristics During 1949 Spring Runoff

Tannin content is given for both the raw river water and tap water. The tannin content, odor number, and nonconfirmatory gas-producing organisms (false presumptives) all increased about Feb. 25, but the turbidity did not increase until Mar. 2. The color reached the highest point on Mar. 12.

It is estimated that 23 per cent of all silt carried by the Missouri River past Omaha is contributed by the Yellowstone River and its tributaries. Algae do not present a real problem in Omaha. During the spring runoff, a large part of the algae present are undoubtedly caught in the sand and heavy soil of the turbulent river and settle to the bottom in the various sedimentation basins through which the raw water must pass before it is coagulated. Coagulation eliminates much of the taste and odor trouble related to algae.

In 1948 there was very little rainfall during the autumn months, and the author noticed that most of the decayed

vegetation had not been washed away but was gathered in the coulees along the stream bed. This decaying vegetation, such as grass, leaves, and underwater weeds, usually results in an odor which may be characterized as grassy or musty. During the spring runoff, when the snow melts and the spring rains occur, the decomposition products of this vegetable matter, mostly of the tannin or lignin type, are dissolved and drained into the river, imparting a dark color and disagreeable tastes and odors.

1949 Conditions

Laboratory tests on tannin were made from Feb. 20, 1949, until after the runoff in April. The procedure used was suggested by A. A. Berk and W. C. Schroeder (1). A tyrosine reagent is reduced by the tannin or lignin to give a blue solution having a color density that varies with the concentration of the reducing agent. This solution is compared colorimetrically with a standard tannic acid solution prepared simultaneously. Checks were made in the laboratory on the tannin content in both the raw river sample and the laboratory tap. Figure 1 indicates that, about Feb. 25, a simultaneous increase occurred in: [1] the tannin content of the raw river water; [2] the odor number of raw river water; and [3] nonconfirmatory gas-producing organisms (false presumptives). Turbidity readings did not increase, however, until March 2. During this period the color gradually increased until it reached the highest point, a color index of 20 in Fig. 1, on Mar. 12, but the tannin content, odor numbers, and false presumptives of the raw river water noticeably decreased.

Coagulation seemed to be an important factor in taste and odor control, as both the tannin content and odor number were reduced considerably after coagulation. Starting Feb. 11, activated carbon was applied in the dosage which the laboratory tests indicated to be necessary to alleviate tastes and odors. The initial 3.0-ppm total dosage rate was increased until 30.0 ppm was applied on Mar. 6, but this dosage did not decrease the threshold odor number to less than 5 until Mar. 14. On Mar. 17, activated carbon was discontinued. The threshold odor number of the raw river water remained less than 5. The raw water had the characteristic earthy, musty odor but was not disagreeable. These facts indicate that the intensity of odors in the raw river water has very little to do with the amount of treatment needed. The nature of the objectionable odor definitely determines the type or amount of treatment required.

On Mar. 20 a very sudden and rapid rise in turbidity was observed, accompanied by an increase in nonconfirmatory gas-producing organisms, whereas a continued decline in tannin content and a sharp decrease in threshold odor values were noted.

The author was unable to correlate the color analyses pattern directly with the turbidity pattern, but observed that the color pattern followed more closely the tannin content of the tap water. The chief operator at the Omaha filter plant has noted, after watching spring runoffs for 30 years, that color is the forerunner of odors to come and the stronger the color, the more pronounced the odor.

From Feb. 21 to Apr. 16, 1949, a total of 1,840 samples from the distribution system were planted in lactose tubes; 1,018 tubes, or 55 per cent, showed evidence of gas-producing organisms but not one of the tubes was confirmed in brilliant green lactose bile. In this same period the chloramine

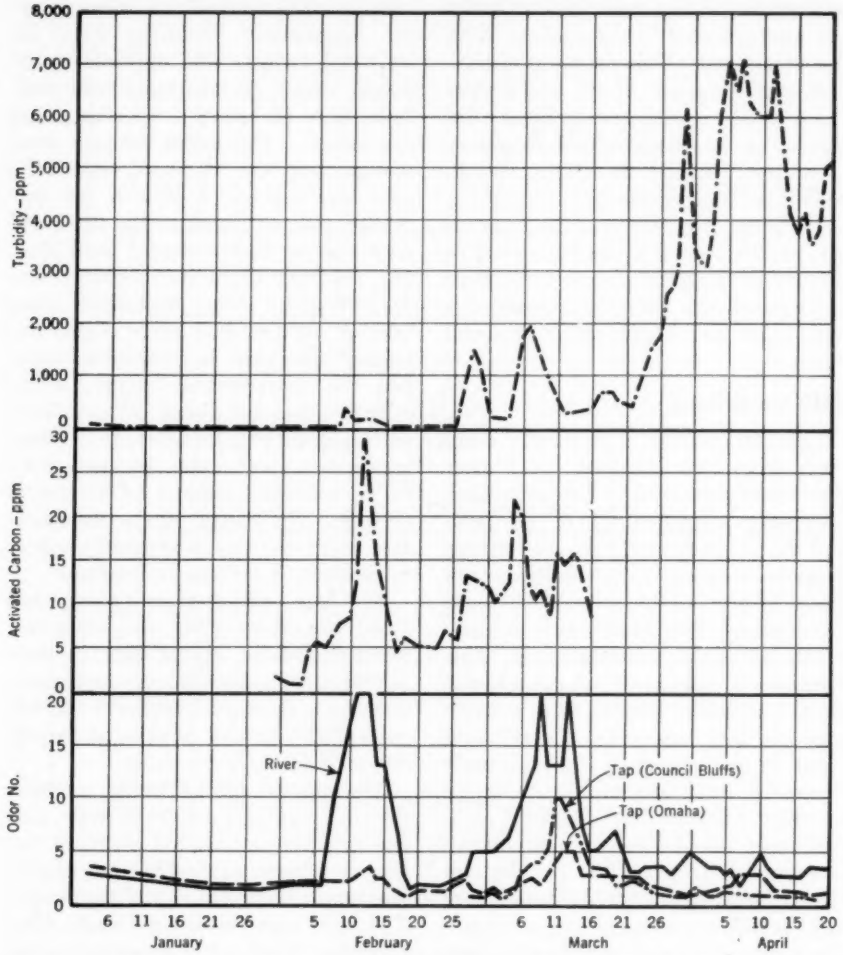

Fig. 2. Water Characteristics and Carbon Dosages During 1950 Spring Runoff

From Jan. 3 to Feb. 9, a musty odor predominated; from Feb. 10 to 15, a combination of earthy and musty odors; from Feb. 16 to 27, a definitely earthy odor; and from Feb. 20 to Apr. 17, a combination of earthy and musty odors. From Feb. 28 to Mar. 15, chlorine dioxide was applied to the Council Bluffs water.

residual averaged 0.75–1.00 ppm throughout the distribution system.

1950 Conditions

In Jan. 1950 threshold odor tests were started before the runoffs and continued until Apr. 17, 1950. During this period, activated carbon was used in Omaha for taste and odor control, whereas M. E. Rew, chemist at the Council Bluffs, Iowa, water plant, relied on prechlorination, and, from Feb.

28 to Mar. 15, chlorine dioxide. Odor tests were made on both the Omaha and Council Bluffs finished water in the distribution system. Figure 2 shows that a total carbon dosage of 30 ppm was applied when the characteristic earthy and musty type odor reached its highest value—an odor number of 20—and reduced it to a slightly chlorinous odor number of 3. Activated carbon reduced all musty or earthy odors to a threshold odor number of 5 or less. None of these odors was disagreeable, but all were definitely chlorinous as a result of the chlorination dosage. Beginning Feb. 28, Rew applied approximately 5 ppm of chlorine dioxide which gave a residual reading of 1.0 ppm and on Mar. 14 and 15 he applied 8-ppm dosages and attained a 1.5-ppm residual, but the threshold odors were accentuated by the predominantly chlorinous "smell." Rew immediately discontinued the use of chlorine dioxide and continued prechlorination. It was asserted by Rew that the chlorinous odors, as checked by the threshold odor tests, were not consistent with the chlorine residual at the plant.

TABLE 1

Nitrate Nitrogen in Tap Water During 1950

Month	Nitrate Nitrogen—*ppm*		
	Low	High	Avg.
January	0.80	1.50	1.10
February	0.70	1.30	0.80
March	1.40	2.20	1.70
April	1.20	1.70	1.45
May	0.50	1.20	0.80
June	0.25	0.95	0.55
July	0.35	0.60	0.45
August	0.25	0.55	0.40
September	0.10	0.20	0.15
October	0.15	0.35	0.25
November	0.15	0.30	0.25
December	0.35	0.50	0.40

During the period from Jan. 1 to Apr. 17, 1950, the characteristic odors of the raw river water changed: from Jan. 3 to Feb. 9, a musty odor predominated; from Feb. 10 to 15, a combination of earthy and musty odors; from Feb. 16 to 27, a definitely earthy odor (Fig. 2 shows that this stage was reached when the odor numbers in the raw river water started to decline); from Feb. 28 to Apr. 17, a combination of earthy and musty odors (again the raw river odor numbers first increased, then decreased and finally held steady, suggesting that most of the agricultural organic material and decayed vegetable matter had been flushed out during the first part of the runoff).

Stream flow data during the past twenty years indicate that the mean flow is approximately 40,000 cfs. On Jan. 3, 1950 (Fig. 3), the Missouri River discharge past the intake screens was 6,000 cfs, and on Apr. 26 it reached 180,000 cfs; the average for the entire year was 40,400 cfs.

The temperature of the Missouri River remained steady at 33 F in the winter months; on Mar. 30 it started to climb, gradually reaching a 65 F reading by May 30. The pH of the Missouri River is fairly constant at 8.0–8.1 during the winter months and, after the spring runoff, it drops to 7.6 and varies between 7.6 and 7.9 during the entire summer.

In the same year, 1950, the Omaha laboratory staff, headed by F. B. Lasell, made an extensive survey of the biochemical oxygen demand and the dissolved-oxygen content of the Missouri River as it passed the intake screens. Figure 3 shows that the BOD increased immediately and in parallel with the rise in turbidity, whereas the DO remained fairly stable. But on further inspection of Fig. 3, it can be seen that, after the initial "flushing"

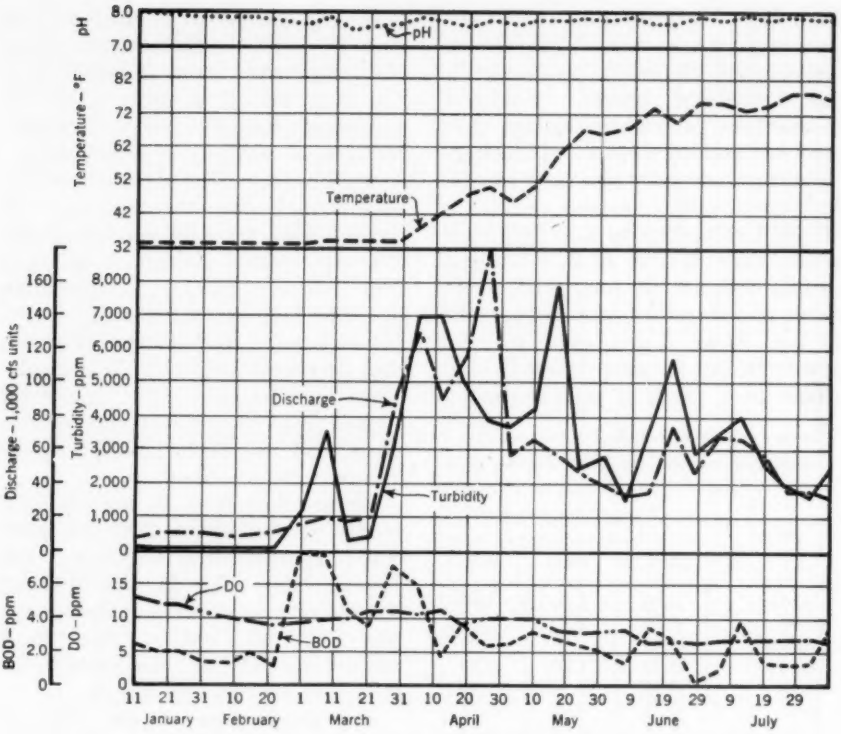

Fig. 3. Missouri River Characteristics During 1950 Spring Runoff

The BOD increased immediately and parallel with the rise in turbidity whereas the DO remained fairly stable. High, low, and average values are given in the following:

	BOD—ppm	*Discharge*—cfs	*pH*	*DO*—ppm	*Turbidity*—ppm	*Temperature*—°F
High	*8.00*	*180,000*	*8.1*	*14.6*	*7,800*	*78*
Low	*0.25*	*6,000*	*7.5*	*6.15*	*30*	*33*
Avg.	*2.40*	*40,400*	*7.8*	*8.65*	*2,100*	*52*

of the river during the spring runoff, the BOD remained fairly stable in relation to the DO. Even though the turbidities again increased in May and June, the BOD and DO remained stable. Following the spring runoff—after Apr. 30—BOD and discharge rate seem to parallel each other closely during the remainder of the year.

During 1950 weekly nitrate nitrogen checks (Table 1) were made on samples from the laboratory tap. In February when the threshold odor number in the river was at the high of 20, the nitrate nitrogen averaged 0.80 ppm; in March, when the threshold odor number again reached 20, nitrate nitrogen averaged 1.70 ppm, but in April the odor numbers in the river remained below 5 and the nitrate nitrogen averaged 1.45 ppm. During this period in 1950 the threshold odor num-

bers of the tap water were never higher than 5.

1951 Conditions

The spring runoff in 1951 occurred very early. From Feb. 18 until Mar. 5, the river rose from a 7.0-ft reading to 10.5 ft, and turbidities rose to 5,000 ppm. Total activated carbon dosage reached 3.5 ppm. Taste and odor complaints were at a minimum. On Mar. 22 the river finally completed its spring runoff but by this time the main Missouri River stem had been flushed out and the activated carbon application averaged 1.0 ppm. Simultaneously, prechlorination was increased to near the breakpoint and during the second spring runoff 8.0 ppm chlorine was applied. At the same time ammonia application was discontinued. Since the 1951 spring runoff, a free chlorine residual has been maintained in the treated water.

Free Residual Chlorination

Free residual chlorination has been used at the Metropolitan Utilities District water plant since Jan. 23, 1952. Flocculation has been aided immensely, which may have alleviated some of the taste and odor problems. Not a single customer complaint has been recorded. The author does not imply, however, that free residual chlorination has eliminated the taste and odor compounds normal to the Missouri River during spring runoff. Another fact that must be considered is the "flood runoff" of 1952, which may have diluted taste and odor compounds so much that they did not affect the domestic water supply.

Conclusion

The water plant men in the Missouri River Drainage Basin cannot prepare themselves year after year for the same climatic conditions, the same taste and odor decomposition products, or the same chemical methods of treatment. The "Big Muddy" varies year after year and methods of taste and odor control must be accommodated to changing conditions. It is not the intent of the author to imply that activated carbon can replace all other means of removing tastes and odors. Each method has its own particular advantages, and each should be used when needed.

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George S. Lee

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The author was introduced to the spring runoff problem approximately twenty years ago while associated with Jack J. Hinman, then professor of sanitation at the University of Iowa. Hinman ascribed the cause to the release of organic matter from plant cells which are broken by the severe freezing weather encountered in this area and described the odor as a "grass tea"—a strong, musty vegetable odor, which presents the surface plant operator of the north central states with one of his most perplexing problems.

Weather conditions preceding and during the spring runoff have considerable influence on the severity and duration of the trouble. A prolonged period of warm weather, especially if accompanied by warm rains, may cause a four- or fivefold increase in threshold

odor number within 24–48 hours on streams having relatively small watersheds, such as the Cedar, Iowa, and Des Moines rivers. Alternate freezing and thawing conditions will slow runoff and decrease the severity of the problem. On the upper Mississippi the increase in odor is somewhat slower, and, in the author's opinion, not as acute as on the smaller, flashy streams.

During spring runoff the turbidity and bacterial count increase and the dissolved mineral content decreases, occurrences that are normally expected when stream flow increases. In addition, there are several other changes in the character of the raw water which are not characteristic of comparable stages and turbidities that occur later in the year. These changes include: [1] extensive foaming upon agitation; [2] high color; [3] high albuminoid nitrogen; and [4] difficult coagulation.

The ammonia nitrogen, nitrates, dissolved oxygen, and pH are largely dependent upon the biological condition of the stream. The author has not been able to correlate the pH values or the ammonia, nitrate, or dissolved oxygen content with the odor changes. The oxygen consumed and free residual chlorine demand usually parallel the turbidity curve; at the same turbidities, however, the odor numbers are higher during spring runoff than they are later in the season.

The Ottumwa water plant takes raw water from the Des Moines River, the watershed of which comprises approximately 13,200 sq miles of farm land above the plant. Untreated domestic sewage or industrial wastes are not usually considered sources of taste and odor problems at Ottumwa.

Ottumwa Treatment

Treatment normally consists of free residual chlorination followed by a 45-min detention period in a plain sedimentation basin. As the water leaves this basin, the coagulant—ferrous sulfate—and lime and soda ash are added. The ferrous sulfate reduces the free residual chlorine to zero. After flocculation the water enters the first of two settling basins, and as it leaves the first basin and passes through the first carbonation chamber, activated carbon is added to the relatively clear water. This point of carbon application allows approximately 2-hour contact in the second basin before filtration. Up to 6 ppm of activated carbon can be fed at this point without causing it to pass through the filters.

Free Residual Chlorination

Free residual chlorination was used continuously at Ottumwa from 1941 until 1950. Since the author went to Ottumwa in 1945 he has been convinced that the odors from the chloroderivative compounds which are formed by high chlorine dosages are more objectionable and more difficult to remove than the original odor which occurs during spring runoff and the later high-algae periods.

The coagulant, ferrous sulfate, is effective, however, in reducing the chlorine to zero after the initial reaction period. During 1949 and 1950, following filtration, a second free residual chlorine dosage was added to the clear well which was then dechlorinated to zero with sulfur dioxide. This treatment was not successful except when carbon doses up to 32 ppm were fed. Under these conditions nitrogen trichloride should not be present at any time after dechlorination. Chlorination following ammonia treatment is practiced at Ottumwa at all times.

During the spring of 1950 when free residual chlorination was used continuously, the maximum threshold odor of

the raw water was 35 and the tap 8. During the spring of 1951 the maximum raw odor number was 50 and the tap 6, using 5.6 ppm carbon without free residual chlorination. The following day the raw odor dropped to 35; free residual chlorination was tried and 8.7 ppm carbon was fed. The resulting tap odor was 8, so free residual chlorination was discontinued, and 6–8 ppm carbon was fed into the plain sedimentation basin, followed by the regular carbon dosage. Tap odors of 2 or 3 were obtained with raw-water odors as high as 40.

During the spring of 1952 the maximum raw-water odor number was 25 and tap odors ranged from 2 to 4. From an operating standpoint the problem was easily handled by discontinuing free residual chlorination and using a maximum of 4.9 ppm of carbon.

Need for Foresight

Those responsible for the operation of surface water plants in the north central states must practice some foresight to combat this problem because of its rapid onset. By watching local and regional weather forecasts, the thaws can be anticipated. At the Ottumwa plant, free residual chlorination is discontinued and carbon feed is increased to meet the situation.

The various physical and chemical changes that accompany the odorous condition are of relatively little value in plant control because the odor is already present when they become apparent. To prevent consumer complaints it is necessary to stay ahead of the trouble. The author has found that numerous threshold odor tests are the most effective tool during this period. When pressed for time, the regular hot odor of the undiluted samples from various points in the plant gives very rapid indications of trouble.

One condition at Ottumwa is probably not found at many other plants. Because of the short detention period after the addition of the free residual chlorine dosage, and the effective action of the heavy softening floc, the bacterial content of the plant effluent does not change appreciably when free residual chlorination is discontinued. The author would not expect this condition to exist in a plant using ordinary coagulation procedure, especially as coagulation usually presents some difficulty during spring runoff.

Conclusion

No two sources of supply can always be handled in the same way, and, as two plants are seldom structurally alike, different approaches may be necessary at different plants. The author's experiences have been offered with the hope that some points may be applicable to the situation at other plants.

Leo Louis

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Whenever the surface water plant chemists and operators get together at Iowa Section meetings, the problem of spring runoff taste and odor troubles is usually discussed at great length, both at public and private sessions. Water works men from Iowa and Nebraska are very anxious to present their problems and, by means of discussion and suggestions, receive some aid in the annual fight to eliminate customer complaints. To the author's knowledge, no one has discovered a solution which will work every time. This panel presents the problem rather than the solution.

Background

The author is a comparative newcomer to Iowa, having gone to Cedar

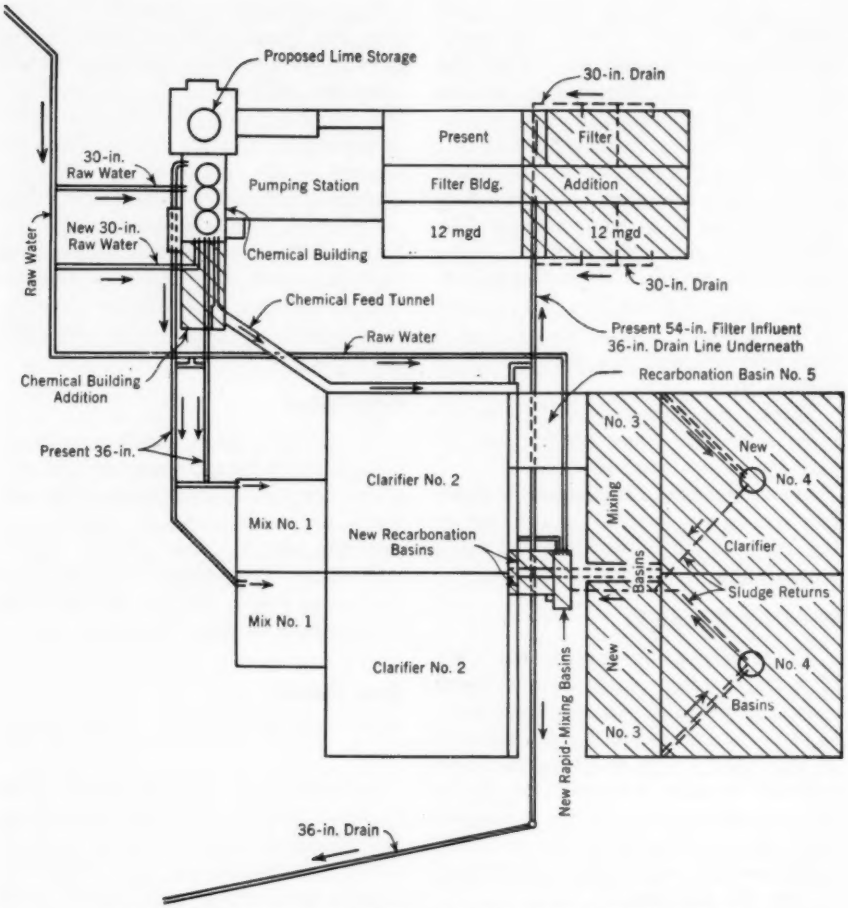

Fig. 1. Plant Basins and Piping at Cedar Rapids Filtration Plant

The diagram shows the treatment units that were in use in March 1950, as well as the new basins that were under construction at that time and are now in use.

Rapids in October 1949. He was warned that the source of supply, the Cedar River, was a flashy stream and that, although normally no serious taste and odor problems were present, severe onsets of odorous water did occur during the spring and sometimes in the summer. The summer troubles are chiefly due to algae and can be controlled by normal procedures. Spring tastes and odors, however, are the result of runoff in the river basin and are not easily eliminated. Unfortunately for the author, the taste and odor experience in the spring of 1950 was the worst that had occurred in Cedar Rapids since 1932. The past two spring runoffs have not produced such bad conditions and have been more easily controlled.

As far as the author knows, there are no major sources of industrial or domestic sewage pollution on the Cedar River above Cedar Rapids, except possibly a cannery at Vinton—35 miles upstream—and the treated sewage effluent at Waterloo—approximately 65 miles upstream. The drainage area above Cedar Rapids, approximately 6,600 sq miles, is primarily excellent agricultural and stock-raising farmland and is probably heavily fertilized with both animal manure and commercial fertilizer.

There was very little rainfall in the river basin in the autumn of 1949 and record low river stages were observed (Table 1). The combination of a very cold winter with the low river stage resulted in the river's freezing to near bottom in many places. The organic refuse on the farmland and in the river bottom had apparently not been disturbed to any degree during the winter, and a quick thaw the first week of March, coming after a heavy snow, flushed all of this accumulation of organic matter into the river at one time.

Table 2 gives chemical and physical data for the first 25 days of March 1950. Figure 1 shows a plan of the Cedar Rapids filtration plant and indicates the treatment units in use in March 1950, as well as the new basins then under construction which have since been placed in use.

Treatment

Raw water enters a low-lift pumping station, located approximately ¾ mile above the plant. Activated carbon is usually applied to the suction well at the pumping station, a practice which permits approximately a 30-min reaction time before the raw water enters the premixing basins at the plant. Years of experience and laboratory tests have proved this point of carbon application to be the most efficient. Carbon has been fed at various points in the plant by using makeshift feeders or by dumping bags into the basins.

Chlorine can be added to the raw water in the premixing basins in the main plant, the secondary rapid-mixing basins, or the clear well. The usual point of chlorine application is the secondary rapid-mixing basins after softening has taken place in the first set of basins. During the spring runoff period, however, the treatment process is changed and softening takes place in the second set of basins. Alum and chlorine are applied to the raw water in the first set of basins.

The author has not tried to maintain a free chlorine residual in the treated water throughout the year. During the summer and fall months the ammonia content of the raw water is low, and the prechlorination treatment usually produces a free chlorine residual in the filtered water. This free chlorine residual is changed to a combined residual by the addition of ammonia and more chlorine, if needed, in the clear well. In November or December, however, when ice forms on the river, the free ammonia concentration increases and remains high until after the spring runoff. It has not been found advisable or particularly advantageous to feed sufficient chlorine to maintain free chlorine residuals during the winter months —in fact, the plant did not have sufficient chlorinating machine capacity or the available chlorine in ton containers, until recently, to maintain a free chlorine residual during the spring runoff period.

The other tool that has been used to combat the taste and odor troubles at the Cedar Rapids plant is chlorine dioxide, which has been employed successfully at certain times in the past both as a postfilter treatment and as an

TABLE 1—*Precipitation Data and Stream Flow for Cedar River at Cedar Rapids, Iowa**

Date	Mean Stream Flow *fps*	Maximum Flow *fps*	Minimum Flow *fps*	Peak Discharge *fps*	Minimum Discharge *fps*	Total Precipitation *in.*
1945–46						
Oct.	1,493	2,260	1,160	27,100	527	1.42
Nov.	1,401	2,350	769	(Jan. 9, 1946)	(Aug. 11, 1946)	2.87
Dec.	1,250	2,610	600			1.81
Jan.	5,983	26,000	890			2.84
Feb.	3,836	8,040	1,450			0.20
Mar.	11,020	23,200	3,560			5.39
1946–47						
Oct.	2,851	6,400	1,680	56,200	620	4.14
Nov.	3,519	5,110	2,470	(June 16, 1947)	(Dec. 19, 1946)	1.96
Dec.	1,721	2,370	620			0.62
Jan.	1,435	2,070	950			2.61
Feb.	2,048	3,650	850			0.33
Mar.	4,348	7,730	1,520			1.32
1947–48						
Oct.	1,167	1,860	961	34,500	565	2.68
Nov.	1,449	1,820	750	(Mar. 3, 1948)	(Sept. 12, 1947)	2.04
Dec.	1,275	2,300	640			1.67
Jan.	827	1,140	600			0.56
Feb.	1,557	10,600	570			2.22
Mar.	13,620	32,500	3,130			2.62
1948–49						
Oct.	753	1,100	555	30,800	429	3.02
Nov.	849	1,180	565	(Mar. 7, 1949)	(Dec. 10, 1948)	2.47
Dec.	731	1,200	429			2.75
Jan.	1,575	2,800	560			3.17
Feb.	1,225	3,600	730			1.52
Mar.	10,310	28,500	3,350			2.49
1949–50						
Oct.	549	838	440	33,000	212†	1.93
Nov.	582	910	520	(Mar. 11, 1950)	(Dec. 10, 1949)	1.14
Dec.	488	928	212†			0.75
Jan.	466	760	230			2.37
Feb.	555	1,590	310			1.28
Mar.	9,979	32,400	634			0.81
1950–51						
Oct.	985	1,200	754	54,100	300	0.23
Nov.	648	802	300	(Apr. 11, 1951)	(Nov. 25, 1950)	0.93
Dec.	543	670	400			1.31
Jan.	480	550	440			1.19
Feb.	2,421	25,400	350			2.20
Mar.	9,000	38,100	2,100			6.35
1951–52‡						
Oct.						6.47
Nov.						1.97
Dec.						1.74
Jan.						1.62
Feb.						0.88
Mar.						4.61

* Data obtained from records of U.S. Geological Survey and U.S. Weather Bureau.
† Minimum daily flow of period of record—1903–52.
‡ There is no data except precipitation data for 1951–52. The flow and runoff were relatively high, however.

addition to the settled water before secondary coagulation.

March 1950 Runoff

Table 2 shows that a total carbon dosage of more than 50 ppm gave rather poor results in March 1950. The carbon reduced the odor fairly well, but as soon as a chlorine dosage was applied the odor increased. This odor was disagreeable, musty, sour, and chlorinous, and a vile taste was also apparent. Equipment having sufficient capacity to try free residual chlorination was not available; laboratory experiments indicated a free residual at a dosage of more than 25 ppm chlorine, but there was no apparent decrease in threshold odor. Later in the month (March 1950), a large-capacity chlorinating machine was installed, and free chlorine residuals were obtained on plant tests, but the results were inconclusive as the runoff was almost finished. Chlorine dioxide apparently had no effect on the odor.

Laboratory experiments did indicate that complete dechlorination with sulfur dioxide might improve the water. Sulfur dioxide was finally tried on a plant scale. The results were apparently good, but the raw water improved at the same time so it was difficult to determine the effectiveness of the sulfur dioxide treatment. The extremely bad conditions lasted only a week or ten days. It was impossible to run laboratory experiments and try the various schemes on a plant scale before the runoff conditions improved naturally.

Ammonia Nitrogen

Unfortunately, the Cedar Rapids plant does not have a very complete history of ammonia nitrogen content as this analysis has been run only infrequently. During the extreme taste and odor period in Mar. 1950, an analysis made on Mar. 18 gave an ammonia nitrogen content of 1.35 ppm. On Nov. 30, 1950, the ammonia nitrogen content was 0.56 ppm and on Dec. 6, 1950, 1.05 ppm; on Jan. 31, 1951, a maximum of 2.0 ppm was noted. During this period there were no taste and odor troubles. The ammonia nitrogen content varies between 1.0 and 2.0 ppm during the winter months. On Apr. 19, 1951, the content dropped to 0.55 ppm and on June 4, 1951, to 0.03 ppm. In 1952 the ammonia nitrogen content has followed the same pattern. A maximum of 1.6 ppm was noted on Feb. 5, and a low of 0.44 ppm on Apr. 7. Consequently, it is impossible to use ammonia nitrogen as a factor in determining the cause or providing information on the treatment of runoff tastes and odors.

1951 Runoff

In the spring of 1951 the runoff occurred in the middle of February. Again the stream flows had been low all fall and winter, but not as low as the previous year. A maximum threshold odor number of 60 was noted in the raw water and the hot odor was similar to the previous year. The vile taste, however, was not as apparent. Chlorine was still not available in ton containers; laboratory results did not indicate, however, that free residual chlorination would eliminate the odor. Laboratory studies did indicate, though, that eliminating lime softening and applying heavy dosages of carbon (40–45 ppm) ahead of prechlorination or chlorine dioxide would produce a satisfactory water having a threshold odor number of less than 5. The plant was placed on this schedule, using soda ash for pH control, with satisfactory results.

1952 Runoff

Heavy rainfall and extremely high runoff occurred in the drainage area all

TABLE 2—*Chemical and Physical Analyses and Data on Water During March 1950 Runoff**

March	Pumpage *mgd*	Avg. Threshold Odor Numbers†								Avg. Turbidity With Carbon *ppm*	Avg. Color Raw Water	Carbon Dosage† *ppm*		Prechlorine Dosage† *ppm*		Sodium Chlorite Dosage† *ppm*		Sulfur Dioxide *ppm*	Post-chlorine Dosage *ppm*
		A	*B*	*C*	*D*	*E*	*F*	*G*	Tap			Intake	*E* & *H*	*E*	*C*	*E*	*K*		
1	7.93	40	8						7	53	17	8.4	0	1.96					0.44
2	6.9	55	8						6	63	21	13.7	0	1.86			0.19		0.18
3	6.9	90	10		5		10	5	5	58	20	11.7	0	2.1		0.34	0.46		0.49
4	6.99	55	7		6		7		2	61	15	13.5	0	1.44		0.65			0.29
5	6.16	40	7						5	137	34	12.1	0	1.2		0.40			0.37
6	5.28	90	37		22		35	26	19	334	50	20.4	0	3.3		0.83	0.18		0.53
7	7.13	78	17	23	21	40	40		40	405	47	48.3	2.2	3.5		0.84	0.52		0.38
8	7.47	70	30	20	18	40	47		32	370	48	48.0	2.3	2.4		0.32	0.92		0.83
9	7.42	90	15				50		35	312	52	29.2	3.8	3.56			0.77		0.61
10	7.49	75	20		18		40		27	322	47	40.5	4.8	3.23			0.76		0.55
11	7.66	75	18		14		30		22	288	49	52.6	4.8	2.74			0.30	0.13	0.32
12	7.37	60		7	6		18		11	272	50	43.5	4.8	2.73				1.39	
13	6.51	40		8.5	5		7		7.5	206	50	41.6	2.9	2.5				0.34	
14	7.04	50	18		7				7	195	40	34.1	0	2.1					
15	7.51	90	22		7		14		5	186	44	35.5	0	2.17					
16	7.75	60	18		7		14		5	198	45	31.8	0	1.98					
17	7.59	70	18		10		22		5.5	188	45	32.8	0	2.18					
18	7.38	90	14		3		10		4.3	117	45	16.1	0		11.0				
19	7.21	60							8.5	78	42	0	0		16.6				
20	6.33	40			14‡			16	14	68	40	0	0		13.7		0.19		
21	7.53	40			18‡	22	22	18	13	64	45	0	0		16.2		0.30		
22	7.25	35	5						12	125	38	12.1	0		7.2		0.22		
23	7.13	35							7	167	25	18.1	0	1.92					
24	7.05	40							5	185	42	17.1	0	1.87					
25	6.71	40							3	226	57	17.8	0	2.38					

* Pretreatment ammonia dosages on March 21 and 22 indicated 0.13 ppm. Posttreatment dosages on March 20 indicated 0.38 ppm and on March 21, 0.27 ppm.
† The italic letters refer to the following: *A*—raw water; *B*—raw water with carbon; *C*—slow-mixing basin No. 1; *D*—clarifier No. 1; *E*—slow-mixing basin No. 2; *F*—clarifier No. 2; *G*—filter effluent; *H*—recarbonation basin; *K*—clear well.
‡ Samples dechlorinated.

during the summer and fall of 1951, and conditions different from those of the preceding winter were present during the winter of 1951–52. The volume of ice on the river or snow on the ground was not as great as that of the previous two winters, and several moderate runoff periods were experienced after January 1. Carbon dosages of up to 10 ppm took care of the first runoff late in January. Early in February the second runoff occurred, and, although raw water threshold odors were not too high —maximum approximately 20—free residual chlorination was started by applying chlorine to the raw water. Chlorination capacity is now adequate and the ton containers are available. The maximum chlorine dosage during February 1952 was 21.7 ppm. Carbon was not applied to the raw water during this period, but it was applied in dosages as high as 10 ppm in the primary recarbonation basins after coagulation and clarification but before softening. A detention time of approximately 6–8 hours was available for the chlorine reaction before carbon application. Carbon dioxide was also released into the recarbonation basins to aid in aeration for removal of nitrogen trichloride. Subsequently, air was pumped into these units for the same reason. This treatment kept threshold odors at values less than 5 in the final effluent. The free chlorine residual was changed to chloramines by application of ammonia to the filter effluent. There were very few customer complaints during the spring 1952 runoff, but raw-water conditions were relatively good.

Bacteria

Another factor to be considered during spring runoff is the type of bacteria present in the river water. The Cedar Rapids water plant has very few nonconfirming (false presumptive) gas formers in its distribution system during the winter months, even when prechlorination is practiced, but as soon as the runoff conditions start, these bacteria show up in distribution system samples. They can then be eliminated by free residual chlorination. It is not likely that there is any particular correlation between the organic compounds and these bacteria except that both are present on or in the topsoil in the drainage area and both are flushed into the stream at the same time.

Several people have pointed out that the runoff troubles might be related to the *Streptomyces* organisms described by Silvey and others (1) and by Ferramolla (2). The temperature conditions and stream types of the Cedar Rapids area are entirely different from those described in the articles on *Streptomyces.* This theory should not be discounted, however, and should be investigated further in the Cedar Rapids area. Middleton and others (3) have described the research work that is being done in extracting the basic organic odor from various waters—probably the true approach to the taste and odor problem. It is to be hoped that such research can be continued in various areas throughout the country.

Summary

The primary factors in the spring runoff taste and odor problem appear to be the organic load on the drainage area, precipitation in the drainage area, stream flow, and possibly temperature. The problem is apparently not due (in the Cedar River) to a specific source of pollution but to a combination of these factors. That a specific source of pollution is not the cause of taste and odor problems during spring runoff has

been proved by the occurrence of the same results in entirely separate drainage basins at the same time.

Stream conditions during the fall and winter appear to be the best indicators of the intensity of the problem the following spring. In the Cedar River, total ammonia nitrogen cannot be used as an indicator because the content is high during all the winter months. Threshold odors still appear to be the best method of determining when to start taste and odor removal treatment, although color and turbidity analyses are useful.

The water plant operator troubled with spring runoff taste and odor problems cannot fully prepare himself or his plant for trouble with the runoff condition. Each year a different method of treatment may solve his problem and what helped one year may be useless the next. Laboratory research can be initiated when the troublesome water enters the plant but the condition usually persists only a few days, and even after the proper approach is ascertained, plant procedures may be too late to eliminate customer complaints.

Acknowledgment

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Taste and odor problems in Iowa surface water which are attributable to spring runoff have been extremely variable in severity, duration, and response to known methods of corrective treatment. The author believes that all of the conventional taste and odor control methods, with the possible exception of ozonation, have been practiced in Iowa plants at some time or other during spring runoff difficulties. None of the methods, apparently, has solved the problem.

Except for the Mississippi River on the east and the Missouri River on the west, Iowa's streams rise in and flow through rich farming areas and are considered relatively clean and free from heavy industrial pollution, as judged by present-day stream standards. One might conclude that, under such conditions, taste and odor problems arising in surface water supplies would be infrequent and of a minor nature—an assumption which, in general, is true. During spring runoff periods in the past, however, conditions have occurred that have placed almost intolerable taste and odor burdens on Iowa's surface water treatment plants. When such severe conditions have occurred, they appeared, for the most part, to be of wide geographical distribution within the state, affecting all water supplies alike, sometimes even to the time of onset and duration.

Origin

These observed circumstances would seem to indicate that the origin of the taste- and odor-producing substances causing the trouble during the early spring periods is not confined to any single area or stream, and in all prob-

ability is associated with the natural breakdown and decay of vegetable matter in and on the soil of the watersheds.

Although not definitely confirmed by weather records, it also appears that the most severe conditions have followed hard winters during which less than normal precipitation has occurred. These conditions have invariably come with the first heavy surface runoff which usually results in some degree of flooding in the early spring. There have been few such occasions when no unusual tastes and odors have developed. This observation also suggests that the spring trouble is traceable to the organic decomposition products accumulated on the watershed during the winter period. High color indexes very frequently accompany the onset of the spring trouble. This color is directly traceable to the tannins which are leached from leaves and other vegetable matter during the natural process of decay.

From the foregoing rather broad observations, it would appear that the foul tastes and odors—generally described as strong, earthy, or musty—so frequently reported during the spring runoff period are carried into the streams by runoff water after being in contact with decaying vegetation during the nongrowing season. Certainly this group of organic compounds is among those which cause problems in water, and about which there is insufficient knowledge. Certain molds have been identified and studied in the laboratory and are known to give rise to an earthy, musty odor very similar to that associated with spring runoff waters. Because of the wide distribution of molds in soil and water in contact with soil, it may well be that these lower forms of vegetation play a greater role in producing tastes and odors in Iowa surface water than is suspected. The minute concentrations of these highly soluble nuisance compounds, have made it impossible to obtain a sufficient quantity of the material for study purposes until very recently. Within the past year, Middleton and others (1) at the Environmental Health Center in Cincinnati have developed an extraction technique whereby these organic compounds may be concentrated in amounts suitable for study. After the groups or individual compounds most likely to cause tastes and odors have been determined, treatment for their removal from water may soon follow.

With all due regard for methods of control which have been developed and used with a considerable degree of success, it is the author's opinion that no method of taste and odor control can be fully successful until the nature of the nuisance material is more fully understood.

Summary

It should be emphasized that experience has repeatedly demonstrated that no method of controlling taste and odor will necessarily be successful in all waters at all times and under all conditions. Until the nature of the nuisance substances that are encountered in each individual water supply is more fully understood, attempts at control are not going to be fully successful.

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Action of Ozone on Tastes and Odors and Coliform Organisms

By Marcus P. Powell, Kent G. Drummond, Cesar Saavedra, Frederick M. Evans, Philip F. Morgan, and Neil B. Fisher

A paper presented on May 4, 1952 at the Annual Conference, Kansas City, Mo., as part of a panel discussion on taste and odor problems during spring runoff (see p. 1127, this issue, for remainder of panel), by Marcus P. Powell, Assoc. Prof. of Hygiene and Preventive Medicine; Kent G. Drummond, Cesar Saavedra, Frederick M. Evans, and Neil B. Fisher, graduate students; and Philip F. Morgan, Prof. of San. Eng., all of State University of Iowa, Iowa City, Iowa.

THE Iowa River has its source in Clear Lake, located in Hancock County at an elevation of 1,215 ft. It flows to the southeast for a distance of 329 miles and has a fall of 685 ft. The basin is narrow, only 14½ miles in average width, and gives rise to only one important tributary, the English River, which has a drainage area of 645 sq miles and a length of 85 miles. The Iowa River drains a total of 4,375 sq miles in Iowa, 3,320 sq miles of which is above Iowa City. Approximately 60 per cent of this area is used for agriculture, and, consequently, the mud and organic material load in the river is very high during rainy seasons.

There are approximately 50,000 people in the various cities and towns along the drainage basin above Iowa City, thus giving rise to various amounts of domestic and industrial wastes in the stream (1). The Iowa River had an estimated maximum flow of 50,000 cfs in 1851 and 33,800 cfs in 1947, and has an average flow of 1,500 cfs and a natural minimum flow of 50 cfs.

The waters taken from the Iowa River have objectionable tastes and odors of an earthy or musty character. The magnitude of these tastes and odors seems to be proportional to the flow conditions of the stream in late summer and fall and is not so much a function of the character of the drainage basin. Heavy growths of algae together with the freezing over of a low stream seem to be the best indication of the intensity of the taste and odor problems the following spring. Certain years, and for the greater part of any year, these tastes and odors are successfully removed with conventional aeration, coagulation, free residual chlorination, sedimentation, filtration, and occasionally the addition of activated carbon. During certain periods, generally when the spring thaws occur and the ice breaks up in the river, the tastes and odors are accentuated. Even when the more complex tastes and odors occur, the conventional treatment removes practically all of the original taste and odor, but, in so doing, other tastes and odors of a medicinal or chlorinous type, which are definitely unpleasant or even nauseating, develop. It is presumed that chlorine combines with certain organic products of de-

composition to form chloroderivative compounds which are responsible for the tastes and odors that develop. To complicate the problem, these tastes and odors become more pronounced the longer the chlorine is in contact with the water. Postammoniation to convert the free chlorine to chloramines seems to prevent development of the tastes and odors in the distribution system but has little if any effect on those produced in the treatment process.

Assuming that most organic compounds responsible for tastes and odors in the Iowa River waters could be oxidized and thus rendered inoffensive, it seemed that an oxidizing agent other than chlorine might be used. Inasmuch as ozone has been successfully used in treating a variety of waters and as its action is primarily oxidation, it was felt that data on its use for taste and odor control in Iowa surface waters would be helpful.

Ozone

Ozone, O_3, is a gas at ordinary temperatures and pressures and has a molecular weight of 48. It is manufactured commercially by synthesis from air or oxygen in a special form of electrical discharge known as the ozonator discharge. When used for water treatment, ozone is synthesized from air. The resulting concentration is approximately 1 per cent by weight. Because ozone is usually in a dilute mixture in air or oxygen, it is more convenient to think of the process of solution as that of a distribution of ozone between two solvents, air and water.

Gaseous ozone undergoes a thermal decomposition to oxygen at ordinary temperatures. This decomposition is accelerated by heat. The reaction is catalyzed by nitrogen pentoxide and by certain surfaces. Ozone in aqueous solution decomposes even more rapidly. In strongly alkaline solutions the decomposition is very rapid.

Equipment

The pilot plant used in this study consisted of eight units:

1. *Constant-head tank.* The constant-head tank maintained a constant rate of flow of raw water of 1 gpm through the pilot plant.

2. *Chemical mixing and flocculating tank.* The rapid mix, which was either air or mechanical, was baffled off the flocculating tank. The flocculating tank was 22 in. in diameter and had 18 in. of water depth, with a total holding capacity of 29 gal and a theoretical detention time of 29 min at a flow of 1 gpm. The vertical paddle in this tank had a speed of 15 rpm.

3. *First settling basin.* The first settling basin was 57 in. long and 26 in. wide, and had a water depth of 27 in. The basin had a capacity of 173 gal and a theoretical detention time of 173 min at a flow of 1 gpm.

4. *Second settling basin.* The second settling basin was 63 in. long and 27 in. wide, and had a water depth of 26 in. The basin had a capacity of 200 gal and a theoretical detention time of 200 min at a flow of 1 gpm.

5. *Rapid sand filter.* The rapid sand filter had a surface area of $\frac{1}{2}$ sq ft. One side was transparent. The carborundum plate underdrain supported 28 in. of anthracite coal * (0.65-mm effective size) and a 3-ft head of water above the filtering medium.

6. *Flowmeters.* The flow from the filter was measured by a $\frac{9}{16}$-in. orifice meter if the flow was discharged directly to waste, or through a $\frac{5}{16}$-in.

* Anthrafilt, a product of the Anthracite Equipment Corp., Wilkes-Barre, Pa., was used.

orifice meter if discharged to the ozone contact tube.

7. *Chemical feed.* The alum, lime, and soda ash were fed from constant-head tanks to the water entering the rapid mix. Chlorine was fed from constant-head tanks to other points in the plant.

8. *Ozone generator and feeder.* The ozone generator † was designed to operate on a 115-v, 60-cycle, a-c circuit. The complete ozonating unit consisted of an air filter, air compressor, air drier, ozone generator, and an absorption column.

The air drier was of the activated alumina type and was regenerated with heat which was supplied by electric heaters embedded in the unit. The ozone generator consisted of an air flowmeter, a voltage control on the primary of the transformer, a pressure gage, and an ozone-generating cell.

The absorption column was a 6-in. spirally riveted steel pipe 15 ft high and internally coated with asphalt. Ozone produced by the generator passed through aluminum tubing to a ceramic diffuser located in the bottom of the absorption column. The ozone-air mixture bubbled through the water flowing downward. Approximately 18-min contact time was provided at 1-gpm flow.

Procedure

Inasmuch as the most difficult period of treatment of Iowa River waters covers only a few weeks, it is impossible to investigate all phases of treatment in any one year. Three methods of treatment have been studied, however, during the past two seasons. The two treatment methods referred to as Treatment A and Treatment B were investigated during the early part of 1951 whereas Treatment C was investigated during the early part of 1952.

Treatment A consisted of mixing the raw water, presettling, coagulation with aluminum sulfate and soda ash, primary and secondary sedimentation, filtration, ozonation, and chlorination.

Treatment B consisted of ozonating the raw water, coagulation with aluminum sulfate and lime, flocculation, primary sedimentation, chlorination, secondary sedimentation, and filtration.

Treatment C consisted of aeration, coagulation with aluminum sulfate and lime, and primary sedimentation on full plant scale. Ozonation, chlorination, secondary sedimentation, and filtration were done in the pilot plant.

In order to evaluate the three experimental treatment methods, full-size plant operation was used as a control. During the experimental investigations using Treatments A and B, the full-size plant was operated according to the following sequence: aeration, activated carbon (5 ppm), coagulation with aluminum sulfate and lime, free residual chlorination, sedimentation, and filtration. During the experimental investigation using Treatment C, the full-size plant operation had been altered and consisted of: aeration, coagulation with aluminum sulfate and lime, primary sedimentation, free residual chlorination, secondary sedimentation, filtration, and postammoniation. The theoretical detention time was approximately the same for the full-scale and the pilot plant operation throughout these investigations.

The three experimental treatment procedures and the full-size plant operation were compared on the basis of threshold odor determinations, chlorine demand, and total chlorine residuals. Ozone dosages were calculated and the

† A Welsbach Model T-19, a product of The Welsbach Corp., Philadelphia, was used.

TABLE 1

Summary of Data for Treatment A

Item	Date									
	1/27	2/5	2/7	2/8	2/10	2/13	2/14	2/16*	2/17	2/18
Threshold odor number										
Raw water	100	40	5	22	40	60	90	200+	200+	200+
Full plant clear well	90	60	4	7	30	30	40	90	150	18
Ozonated filtered water	7	22	2	5	2	5	18	3	4	7
Ozonated and chlorinated	14	18	3	7	14	7	10	10	4	10
Total residual chlorine—*ppm*										
Full plant clear well	1.6	2.0	1.7	1.5	1.5	2.4	2.4	2.5	2.5	2.5
Ozonated and chlorinated (3–4-hour contact)	2.1	2.2	1.9	2.0	1.8	1.8	2.2	2.0	2.2	1.6
Chlorine demand—*ppm*										
Full plant treatment	21.6	18.4	16.8	16.0	16.7	22.2	22.2	15.9	24.9	27.1
Ozonated water	1.3	1.2	3.9	3.1	3.3	3.3	4.4	6.5	4.6	3.5
Ozone dosage—*ppm*	2.9	3.0	3.2	3.1	3.1	3.0	2.9	2.8	2.9	3.1

* Heavy rain and thaw.

ozone concentration was measured at the end of the predetermined contact time. The reduction in the most probable number of coliform organisms in Iowa River waters by ozone was studied during 1951.

Results

Treatment A covered a period of 23 days. As shown in Table 1, the threshold odor values of the raw water ranged from 5 to approximately 200 during this period. The full-size plant treatment essentially removed the original odors, but other odors of a medicinal character were produced, giving a final range of objectionable threshold odor values of 4–150. One threshold odor value increased from 40 to 60. Treatment A reduced the threshold odor values to a range of 2–22 before chlorination and to a range of 3–18 after chlorination. The odors were of the same general character as those found in the full-size plant operation.

The chlorine demands and total chlorine residuals for the full-size plant treatment and Treatment A, and the ozone dosage for Treatment A are also given in Table 1. The chlorine demands for the full-size plant treatment ranged from 15.9 to 27.1 ppm; the total residual range was 1.5–2.5 ppm. The ozone dosage for Treatment A was 2.8–3.1 ppm and the chlorine demand was 1.2–6.5 ppm, whereas the total chlorine residual was 1.6–2.2 ppm. In order to compare the two methods of treatment, efforts were made to maintain approximately the same chlorine residuals in the finished waters from the two plants.

Inasmuch as the threshold odors were greater than 5 for Treatment A (eight out of the ten runs), Treatment A was not considered satisfactory. In accordance with the theory that more contact time was necessary between ozonation and chlorination and that the oxidized materials might be removed

TABLE 2

Summary of Data for Treatment B

Item	Date													
	2/27	3/1	3/2	3/6	3/7	3/8	3/9	3/10	3/14	3/20	3/21	3/23	3/24	3/27
Threshold odor number														
Raw water	18	10	30	10	2	10	5	90	60	150	30	22	22	22
Full plant clear well	5	4	7	10	4	5	3	18	4	30	90	2	18	1.5
Ozonated raw water	5	30	7	14	10	14	4	22	4	14	40	40	40	18
Ozonated and chlorinated	1.5	2	1.5	1.5	5	3	3	1	1	1	1	2	1	1
Total residual chlorine—*ppm*														
Full plant clear well	2.2	3.2	2.0	2.5	1.7	3.0	2.0	2.8	2.0	1.7	1.7	2.4	2.8	2.6
Ozonated and chlorinated (24-hour contact)	0.6	2.0	1.5	0.8	3.0	2.0	0.7	0.6	1.3	0.7	0.8	0.7	1.0	0.5
Chlorine demand—*ppm*														
Full plant treatment	15.7	14.7	14.3	14.8	13.1	11.8	10.5	10.1	10.7	10.4	11.0	9.8	8.2	9.5
Ozonated water	4.4	3.0	3.5	2.4	3.6		3.3	4.4	2.7	2.5	2.1	2.9	2.2	3.1
Ozone dosage—*ppm*	3.3	1.8	1.8	3.1	3.1	3.1	3.2	3.1	3.2	3.1	3.4	3.2	3.2	3.2

by coagulation, Treatment B was initiated.

Treatment B covered a period of 29 days. As shown in Table 2, the threshold odor values of the raw water ranged from 2 to 150 during this period. The full-size plant treatment again essentially removed the original odor from the water, but for several days during the experimental period the medicinal odor described earlier was produced. The final range of objectionable threshold odors for the full-size plant was 3–90. Twice, the threshold odors increased, once from 30 to 90. Treatment B reduced the threshold odor values to a range of 4–40 before chlorination, and 1–5 after chlorination. The odors remaining in the water after Treatment B were not of a medicinal character.

The chlorine demands and total residuals for the full-size plant treatment and Treatment B and the ozone dosage for Treatment B are also given in Table 2. The chlorine demands for the full-size plant treatment ranged from 8.2 to 14.8 ppm; the total chlorine residual ranged from 1.7 to 3.2 ppm. The ozone dosage for Treatment B was 1.8–3.2 ppm and the chlorine demand was 2.1–4.4 ppm; the total chlorine residual ranged from 0.7 to 2.0 ppm. As in Treatment A, the chlorine residuals of the experimental waters and the finished water of full-size plant were maintained at approximately the same level, except contact time in Treatment B was 24 hours instead of 3–4 hours.

In comparing the two methods of treatment, it should be noted that the maximum threshold odor values of the raw water were essentially the same for Treatments A and B. The odor during Treatment A was considerably more objectionable, however, than during Treatment B. The maximum threshold odor value of the raw water during Treatment A was approximately 200. This value was reduced to 10. During Treatment B the maximum threshold odor value for the raw water was 150 which was reduced to 1.

Although the threshold odor values of the ozonated and chlorinated water obtained in Treatment A after 4-hour contact were low, a definite undesirable taste developed after 24-hour contact. The threshold odor values of the ozonated and chlorinated water obtained in Treatment B were much lower than those for Treatment A, and, in addi-

TABLE 3

Summary of Data for Treatment C

Item	Date											
	2/27	2/28	3/1	3/1	3/2	3/3	3/5	3/7	3/11	3/12	3/14	3/19
Threshold odor number												
Raw water	14	18	10	10	10	10	7	5	10	10	14	18
Full plant clear well	2	2	4	3	2	2	2	2	3	3	2	3
Ozonated settled water	7	10	5	7	7	10	7	18	14	7	10	7
Ozonated and chlorinated					10	10	7	4	22	22	14	10
Total residual chlorine—*ppm*												
Full plant clear well	1.5	1.5	1.5	1.5	1.2	1.1	0.5	1.5	1.0	1.0	1.0	1.0
Ozonated and chlorinated					(trace)	(trace)	(trace)	0.5	1.0	0.4	0.2	(trace)
Chlorine demand, full plant treatment—*ppm*	7.2	7.5	4.3	6.2	7.0	5.8	5.8	5.8	9.7	8.6	0.2	6.8
Ozone dosage—*ppm*	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74

tion, the water did not develop undesirable tastes after 24-hour contact.

Treatment C covered a period of 22 days. As shown in Table 3, the threshold odor values of the raw water ranged from 5 to 18 during this period. The full-size plant treatment reduced the threshold odor values to 4 or less during this period, whereas the pilot plant treatment failed to reduce the threshold odor values materially. Twice, an increase in threshold odor values was noted before chlorination and three times after chlorination. The medicinal odor mentioned earlier was not noticed during the period covered by Treatment C. When the raw water was treated in jars with free residual chlorination as in treatments A and B, it was noted that the chlorine demand was approximately 30 ppm instead of 4.3–9.7 as indicated in Table 3. It was also noted that free residual chlorination of the raw water produced a medicinal odor and the threshold odor values were 40 for the finished water as compared to 10 for the raw water.

The results obtained using Treatment C compare favorably with the results obtained using Treatments A and B when approximate raw-water threshold odors are considered. These results indicate that ozone is a satisfactory treatment for Iowa River waters only when the threshold odor values are high.

Reduction of Coliform Organisms

The experimental values for the bacteriological determinations for reduction of coliform organisms by ozonating raw Iowa River waters are interesting. A significant reduction in coliform organisms was obtained even during periods of relatively high turbidity. The most probable number of coliform organisms per 100 ml of raw water varied between a maximum of 160,000 on May 26, 1952, and a minimum of 400 on Aug. 16, 1952. The most probable number of coliform organisms per 100 ml of ozonated water varied between a maximum of 900 on June 22, 1952, and a minimum of zero that was achieved during a five-day period in August 1952. The percentage reduction varied between a maximum of 100 in August and a minimum of 96.8 on July 24. Average values throughout the coliform study are:

Raw water—*MPN*	16,000
Ozonated water—*MPN*	100
Reduction—*per cent*	99.4

As the lowest percentage reduction was 96.8 and an overall average reduction of 99.4 per cent was achieved, the results of this investigation are in close agreement with the 95 per cent reduction reported by Bartuska (2) and Hann (3).

During five days in August when the turbidity was below 100, the bacteriological results for the ozonated water indicated a 100 per cent reduction in coliform organisms. A slight trace of ozone residual was detected in the ozonated water during this period.

Summary

The threshold odor values for the ozonated pilot plant waters were lower than the raw-water values when the raw-water values were high. When the raw-water threshold odor values were low, ozonation provided very little improvement.

Free residual chlorination was necessary after ozonation in order to reduce the threshold odor values to acceptable amounts. It was found that the chlorination should be done several hours after ozonation to produce waters that did not develop objectionable tastes after 24-hour storage.

Ozonation materially reduced the chlorine demand and sometimes practically eliminated it. An average reduction of 99.4 per cent in the most probable number of coliform organisms per 100 ml of water was noted. It can be concluded that ozone satisfactorily reduces the tastes and odors in Iowa River waters when the raw-water threshold odor values are very high but is of little use when these values are moderate to low.

Before ozonation can be recommended for midwestern waters, the length of time that it would be of value, other possible treatment procedures, and maximum threshold odors that the customers would tolerate must be critically evaluated against the cost of the installation and operation of ozonating equipment.

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Selling Rate Adjustments to Citizens

Panel Discussion

A panel discussion presented on May 5, 1952, at the Annual Conference, Kansas City, Mo.

Leonard N. Thompson

Gen. Mgr., St. Paul Water Dept., St. Paul, Minn.

THIS panel is not designed to discuss the subject of water rates as such but rather the means of obtaining public acceptance with a minimum of adverse reaction. A few remarks on the subject of rates is in order, however.

It is unfortunate that water works men too often shy away from a rate increase when good business judgment indicates the need for such a step. Such a shirking of responsibility often results from lack of confidence in public relations.

Increased Costs

Except for two rather short periods, costs have risen steadily since 1945. Increasing price levels have disturbed the relationship between revenues and costs, making it the duty of every manager to study very carefully the adequacy of his present rate structure.

The author feels that the customer is aware of the increased costs and appreciates that such increases are reflected in water department operating costs. Customers generally are fully aware of the city's growth and recognize the need for expanded water facilities. The author is convinced that all citizens take a just pride in civic accomplishments when completed, provided, of course, that the program has been well conceived and economically prosecuted. In the beginning it may be necessary to sell an idea. This is the time when good public relations will go to work and when good will pays big dividends.

The average customer prefers good service at a fair price to poor service however low the price. He has a right to demand the kind of service that a well-operated department can give, and a department should have the right, and certainly has the obligation, to ask a price which will make possible this kind of service.

Public Relations

For approximately 40–50 years water rates have been discussed by the American Water Works Assn., but only within the past few years has serious attention been paid to the equally important subject of getting the public on the water utility's side in any rate question. This matter of public sentiment is a very important item. Abraham Lincoln is credited with the statement: "Public sentiment is everything; with it, nothing can fail; without it, nothing can succeed; he who molds public sentiment goes deeper than he who enacts statutes."

Big business spends millions of dollars in its efforts to create good will. No water department has this kind of money, but water utilities can do a pretty good job of public relations by

telling their story to the public while remembering that no amount of good publicity can ever make up for poor service.

The author feels sure that the panel discussion which follows will confirm the thought that a successful rate campaign must consist of two essential elements: [1] a rate structure which can be justified; and [2] an effective and positive promotional background—that is, a continuous policy of maintaining good public relations.

Morris S. Jones

Chief Engr. and Gen. Mgr., Water Dept., Pasadena, Calif.

Pasadena, Calif., is a city with a population slightly greater than 100,000. The city is located in the San Gabriel Valley approximately 11 miles northeast of Los Angeles. November 1, 1952, marked the fortieth anniversary of municipal water works operation. The water department operates on the money received from the sale of water. No tax money is available for water department purposes, but, on the other hand, the water fund cannot be used for other city purposes.

Pasadena has a board of directors–city manager type of government. All department heads report directly to the city manager. Each department stands on its own feet financially, and pays for all services that another department furnishes.

Rate Increases

Changes in the water rates in Pasadena have been rather infrequent. The rate established when the department was organized in 1912 remained in effect until 1923, when an increase of 15 per cent was applied. In 1940 the rate was lowered to within a few cents of the original rate. Then, in 1948, the high cost of operation caught up with the department and made a 20 per cent increase in the cost of water necessary. This increase was not enough, however. Three years later, in April 1951, it was again necessary to raise the water rates. This time, the increase was approximately 13 per cent. The last two rate increases totaled approximately 33 per cent.

Water in Pasadena has always been comparatively cheap. Before 1948 the charge for water through a ¾-in. service was $1.00 for the first 500 cu ft. Water sold over the minimum, up to and including 10,000 cu ft per month, was 12 cents per 100 cu ft, with the rate decreasing to 10 and 9 cents for the higher blocks. In 1948 the minimum rate was increased 25 cents per month to $1.25. Water sold over the minimum was increased from 12 to 14 cents up to 10,000 cu ft per month, and from 10 to 12 cents for the next higher block. The second rate rise added another 25 cents to the minimum, making it $1.50 for 500 cu ft. Another cent was added for every 100 cu ft of water sold above the minimum. Therefore, the total increase is 50 cents per month on the minimum charge and 3 cents per 100 cu ft for all water used over the minimum. The average monthly bill before the rates were increased in 1948 was $3.05. The average bill is now approximately $4.02 per month.

In asking for an increase in water rates, it was first necessary to prove to the city board of directors that additional funds were needed to operate the department, but this task was not difficult. Since 1940 Pasadena has been experiencing a rapid growth. In 10 years the population of the city has in-

creased from 82,000 to 104,600, a gain of 30 per cent. Because of this high rate of growth, there was urgent need for more reservoir storage, new water mains, and additions to warehouse facilities.

The cost of labor and materials has skyrocketed since 1940. By 1951 labor costs had advanced more than 100 per cent, cast-iron pipe 106 per cent, and copper pipe 170 per cent. The biggest expense was the purchase of Colorado River water, which rose in price from $15.00 to $20.00 per acre-foot. This increase in price, coupled with the series of dry years that Pasadena experienced in the late forties, made the expenditure for outside water the largest item in the budget.

Public Opinion

After study by the city board of directors, all this information on population and cost increases was given to the newspapers for publication. Little adverse comment was received from customers—in fact, many stated that they felt the increase was justified. A further reason for the acceptance of the rate increase without protest was that today's constantly rising commodity prices had made the customers amenable to a small increase in their water bills. Another circumstance which may have influenced the customers was the fact that 1951 was the seventh year of a period of less than normal rainfall. Two neighboring cities had not kept up their water systems because of lack of funds, and, as a result, shortages had occurred from time to time. The author feels that Pasadena people understood this situation and were willing to give the department additional revenue in order to maintain the system according to the best practice.

Conclusion

Neither the city board of directors nor the water department received one written protest. Pasadena officials believe that when the public is fully informed of the need for additional revenue to operate the water system, it will favor any reasonable increase in rates rather than suffer impairment in water service.

J. Clark Keith

Gen. Mgr., The Windsor Utilities Commission, Windsor, Ont.

Windsor, Ont., is a community of 135,000 persons having only one newspaper. As a natural consequence, only one editorial opinion reaches the public on any civic undertaking. Through no other channel can public confidence be created or destroyed so effectively as through editorial comment. It has been said that good will is "the mightiest practical force in the universe," and the press might be rated first in importance in creating that good will.

Except for a few company towns, there are no privately owned water systems in Ontario. Water rates are subject to neither control nor scrutiny by any regulatory body. When revenues are inadequate to meet operating expenses, the rates are simply raised. It is necessary to have a well-informed public, however, before such action can be taken.

The public has a reasonable right to be told the truth, even if it is unpalatable. Alibis, denials, or attempted evasions of responsibility create distrust. These statements sound somewhat platitudinous, but, nevertheless, as a result of such a public relations policy, the Windsor, Ont., water department has rarely been the target for criticism.

Customer Education

The education of water customers to an understanding acceptance of the rate increases occasioned by plant expansion at inflated costs is not a goal that can be achieved overnight. Rather, it is the result of a long, intensive, and carefully prepared program of public relations. It is the reward of a continuous campaign to lay the ghost of "Gildersleeve," that popular concept of the "office holder" who is held in affectionate contempt by his fellows.

It has been the author's experience that an effective public relations program must be predicated on the confidence of the press in the administration of the utility—a confidence which, in turn, is reflected in community thinking. This desirable result can be achieved rather through newspaper stories and advertisements.

The press, through its reportorial or editorial staff should have access to, and be informed on, any and all matters having a bearing on the operating policy of the utility which would in any way affect water users. Not once in 30 years has the Windsor water department encountered a breach of reportorial trust when the press has been informed in advance on matters which could not, at the time, be disclosed. The press is free to cross the threshold of the Windsor water department at any time.

There should be a modest budget for display advertising. The amount should be a matter for each water department to determine. In Windsor it amounted to approximately 0.25 per cent of the utility's income.

Display Advertising

In utilizing display advertising space, the water department has nothing to sell except the service which might reasonably be expected of it. Through display advertising, however, an accounting can be made to the public on what the water department is doing. At Windsor, display advertising space has been used effectively for several purposes:

1. Periodic statements on matters of policy have been presented in a form understandable to the man in the street. This field is broad and can include many subjects.

2. The utility has been associated through sponsored advertising with worth-while national undertakings, such as the Red Cross, cancer funds, and the Community Chest. These drives can affect everyone in the community, and public reaction to the support the utility has given them was never unfavorable. These advertisements have taken the form of a plea to the public for support. Cash contributions are never made.

3. The need for seasonal conservation or use restriction in emergencies has been explained.

4. Information has been provided on the cost of water as related to other commodities with which the user is familiar. Water has not suffered by this comparison.

5. Factual announcements of rate increases have been carefully presented. This item is especially important.

In 1947 a construction program estimated to cost $2,000,000, which could not be obtained without raising rates, was announced. Two years later, rising costs indicated that this amount was incorrect. The public was informed that rates would be increased but information on the amount of increase or when it would go into effect was not given. The water utility showed that the hourly wage paid in 1950 was more

than double that of 1939, and that materials had also doubled in price. Despite these rising costs, water rates had been reduced three times between 1939 and 1950. Later, the public was informed that these reductions, in the face of rising costs, were errors in judgment. The utility pointed out that these lowered rates, over a 10-year period, represented a saving to each customer of his total water bills for a period of two years. As an item in the customer's overall household budget in relation to income, the cost of water was less than half what it had been 10 years ago. Before making any announcement on rates, graphic information on wages, materials, and the cost of living, was presented. This information was given in a series of statements spread over a year. With the preliminary work completed, the announcement on rate increases was made at the end of the year. A display page depicting a package of cigarettes, a commodity in common use, was employed. The increased cost of water for a year amounted to the price of five packages.

The Press

By coincidence, the Windsor *Daily Star* carried an editorial the same day, which stated in part:

In view of the tremendous inflation of the past few years, it is remarkable that water rates are lower than a decade ago. And the capital developments for 20 years have been paid out of current revenues. It is all very well to say that water from the river doesn't cost anything. But the wages and materials have gone sharply up in the cost to the Utilities Commission. It has been able to keep its charge down while those for education and other civic services have advanced rapidly. If all other goods and services had been provided us with the same price record as water, there would have been no inflation at all.

Four days later a follow-up editorial appeared:

For the past decade, every so often, people cheered because water rates either did not go up or were reduced slightly. In a period when other costs were rising, there was something to talk about in the comparatively low cost of this utility. But the honeymoon is over; water rates rise by 13 per cent. It is not a pleasant prospect but nothing can be done about it. Water rates have been kept down. This increase is an indication that rising costs have caught up here too.

Such were the judgment and comment of the press. Criticism by the public was lacking to a degree. Inasmuch as, basically, the opinion of the man in the street—the customer—is molded largely by what he sees in the paper, it was evident that through cooperation with, and effective use of, the press, the water utility had conditioned its citizens to understand and accept rising rates in a spirit of mingled resignation and good will.

A. P. Kuranz

Mgr., Waukesha Water Utility, Waukesha, Wis.

A municipally owned water works in Wisconsin is considered the same as a privately owned one in every respect and is permitted to earn 5.5 per cent on the utility's rate base. This rate base is determined by starting out with the value of the utility plant, plus inventory of materials on hand which will later become part of the capital structure, plus a working fund (which is dependent upon the size of the utility), *less* depreciation reserve and any monies which have been advanced by the cus-

tomers for aid to the water works for construction.

Public Service Commission Rulings

Thus, the utility management must have all of the information that might have a bearing on the earnings of the utility. As all utilities in the state of Wisconsin must comply with the uniform system of accounting established by the Public Service Commission of Wisconsin, several facts must be presented in a rate case before the commission:

1. The value of the plant as shown in the utility's yearly report to the commission.
2. The amount of material on hand, which will later become part of the capital structure.
3. Contributions which customers may have made toward extension of the plant, from the early years of its development to the present time.
4. The total amount of depreciation set up and carried forward year after year.

Depreciation of the various plant items is established on a basis approved by the Public Service Commission. A few of the classifications used in Waukesha, and the rate of depreciation, in years, for each include:

Wells	50
Pumps and motors	25
Cast-iron mains	150
Services	50
Hydrants	75
Meters	40

The following is that part of the statute (Sec. 66.069–1C–Charges) which covers the disposition of the income of a public utility owned by a municipality:

The income of a public utility owned by a municipality shall first be used to meet operation, maintenance, depreciation, interest, and sinking fund requirements, local and school tax equivalents, additions and improvements, and other necessary disbursements or indebtedness. Income in excess of these requirements may be used to purchase and hold interest bearing bonds, issued for the acquisition of the utility, or bonds issued by the United States or any municipal corporation of this state, or insurance upon the life of an officer or manager of such utility, or may be paid into the general fund.

Rate Structure

The income of the utility is made up of two main items, the sale of water and fire protection service, both public and private. Operating revenue deductions are broken down into four major classifications:

1. Operating expenses, including such items as pumping expense, distribution expense, customers' accounting, and administration
2. Local property taxes
3. Depreciation
4. Interest on bonds and sinking fund requirements

If the net income of the utility established on the rate base does not equal 5.5 per cent, the utility can properly ask for an increase in rates. As the income of a water utility comes from the sale of water and fire protection service, considerable study is necessary to determine what share must be borne by each class of revenue producer. The method of determining what share shall be borne by each group is sometimes quite detailed and calls for considerable study.

Most utilities engage a consultant to prepare the details of the rate structure itself. This consultant may be a professional engineering organization or one that specializes in rate analysis.

Regardless of the type of consultant, it behooves the utility to go before the Public Service Commission well prepared with all records, facts, and figures, so that all statements can be substantiated and supported by evidence.

Notifying the Public

After this preliminary work has been completed, the management must present its case to the customers and the city at large. The newspapers must be notified and given the whole story. The press must have all the information and figures that are available in order to present a clear-cut case to the reading public and the customer.

Inasmuch as both publicly and privately owned water utilities in Wisconsin are operated on the same basis, any earnings in excess of the 5.5 per cent permitted by the Public Service Commission accrue to the benefit of the water utility first, and secondly to the water users and the city at large. Should the earnings be excessive, the Public Service Commission could, on its own motion, institute proceedings to lower the rate. On the other hand, the customer, also, has been kept informed of the needs of the utility, and he recognizes that if the water user does not pay to keep the concern operating efficiently, he will have to come to its rescue later on through increased taxes.

Conclusion

Thus, it is necessary for the management of a water utility to know the costs, keep the books as prescribed by law, and keep the customers informed on any matters that may have an effect upon the rate structure. Then, when the proper time comes for a rate increase, very little opposition develops. Those who do oppose the increase can be shown that it is simply a matter of good business, and the public likes good business because the plant actually belongs to them.

W. R. LaDue

Supt. and Chief Engr., Bureau of Water & Sewerage, Akron, Ohio

Akron, Ohio, a city of 285,000 people, is highly industrialized for both peacetime and wartime production, swinging from one to the other with the greatest facility. To support a $5,000,000 expansion program, the last increase in water rates was put into effect on Jan. 1, 1921. Since then a reduction in debt service requirements has made advisable several minor rate reductions. A $6,000,000 expansion program in 1929 and a $5,000,000 program in 1948 were readily financed by revenues under existing rates. Since 1948, however, and particularly since 1949, rapidly increasing labor rates, rising material costs, increasing maintenance expense because of an older plant, and need for expansion have all worked together to make a rate increase not only desirable but absolutely necessary.

Expansion Program

Water use in Akron has increased 65 per cent since 1940. Today industry uses 40–45 per cent of all water pumped. The Akron water department has always prided itself on being able to keep ahead of the demand. The rapid increase in water use made it imperative that the department take steps to protect its position. Consequently, a $7,500,000 improvement and expansion program was outlined. To sell the program, the following approaches were used:

1. The program was sold to all the people and all groups concerned through the press, radio, and public addresses.

2. As industry is such a large user, the Akron Chamber of Commerce Industrial Water Engineering Committee had to be sold on the program and its necessity.

3. After the program was approved, the Chamber of Commerce Industrial Water Finance Committee was convinced of the need for additional money to support the program through increased rates in accordance with the rate schedule suggested. This new money will be used not only to finance the program, but also to offset increased operating and maintenance expenses.

Cooperation

In Akron, the water department is a separate institution; its financial obligations are its own and its funds are not transferable to other departments. It pays for its own operations and maintenance. It finances its own improvements and it liquidates its own debt. By state law, the fixing of rates is vested in the director of public service upon recommendation of the superintendent of water. In Akron the mayor, his cabinet, and the council favored the water department with their cooperation once they understood and approved the program. The local newspaper was very helpful, even though it appeared that the program could not legally be explained to the public through the medium of paid advertisements.

The rate adjustment at Akron has been successful for several reasons:

1. It was fully justified and carefully explained.

2. The water department had gained an enviable reputation for keeping ahead of all demands.

3. A conservative, well-balanced program, necessary to maintain the water department's position as a supplier, was presented.

4. The water department had the support of its biggest customers and the good will of the public and the press.

The usual comments heard were: "We expected it," and "We get our money's worth at the water department." Thus, the water department sold its program.

C. F. Wertz

Resident Engr., Dept. of Water & Sewers, Miami, Fla.

On July 10, 1950, the Miami, Fla., City Commission voted in favor of a change in rates charged customers for water. It was estimated that the change would increase revenues by approximately 14 per cent, and, after being in effect 18 months, the actual increase was very close to half that amount. The action of the commission followed two years of intensive effort on the part of the Miami Water and Sewer Board. This increase in rates was the first since 1924 and during the interval there had been one decrease.

Before July 1950, rates in Miami were an antiquated combination carried over from the period when the city owned the raw water supply system, the softening and purification plant, and the low-pressure transmission mains, while the Miami Water Co. owned the distribution system and the high-pressure pumping stations. The old rates contained a number of loopholes by which customers obtained a considerable volume of free water.

Publicity

Since rate making is a function of the Miami city commission, it was not necessary to sell the people on the idea of

an increase except as public opinion might affect the commission's thinking. Early in 1948, publicity was given to the $10,000,000 expansion program of the water department, including the actual letting of a contract for the manufacture of approximately $1,500,000 worth of 48- and 42-in., high-pressure concrete pipe as the initial project. Such publicity continued throughout May, and in June 1948 the first newspaper article appeared, with the headline, "25 Per Cent Water Rate Hike Sought."

During 1949 and 1950, W. A. Glass, director of the Dept. of Water and Sewers, J. E. Preston, chairman of the Water and Sewer Board, and the author gave a number of talks before civic groups. These addresses helped to mold public opinion.

Rate Survey

In order to have intelligent information to submit to the commission, the following steps were taken:

1. A statistical corporation was employed to make an analysis of all bills for the year ending Dec. 31, 1947. The one-step method of bill analysis was used on 20,788 monthly and 165,873 quarterly bills.

2. The water department's consulting engineers prepared a report covering an investigation of current rates for the purpose of developing a new schedule which would increase the revenues approximately one-third.

Civic Action

In December 1948 a request was sent to the commission for a rate change which would give an approximate 33 per cent increase. By a resolution adopted Jan. 5, 1949, the commission took adverse action and requested the city manager to make a study and report. This report, submitted Feb. 4, 1949, recommended that the city commission approve a schedule which would limit increases in rates, with some exceptions, to a maximum of 20 per cent. No action was taken.

In 1948 the mayor appointed a citizens' committee known as the Long-Term Capital Improvement Committee to make recommendations to the commission. Shortly after the commission meeting of Feb. 4, 1949, the matter was referred to a subcommittee on water supply for further study, and for the next five months voluminous data were compiled and turned over to this subcommittee.

In October 1949 the department's consulting engineers were again asked to study rate schedules which would eliminate the free water served to certain customers and provide a nominal increase in rates. The engineers' report, submitted Nov. 25, 1949, proposed three separate plans, each involving a step-form rate. The first plan would yield approximately 2.5 per cent additional revenue; the second, approximately 14 per cent; and the third, approximately 9.5 per cent. This comprehensive report indicated that, under any of the three plans, certain customers would actually receive decreases in their bills as a result of the outdated existing rate.

A report from the Water and Sewer Board entitled, "Report Accompanying Request for Change in Water Rate Structure," dated Jan. 13, 1950, was submitted to the city manager, and on Apr. 18, 1950, a new request went to the city commission asking approval of a rate change which would increase revenues approximately 14 per cent in accordance with the second plan sub-

mitted by the consulting engineers. No immediate action was taken.

At approximately the same time the matter of a surcharge on water bills to pay for engineering costs on the sewer project became a burning issue before the city commission. The newspapers headlined such statements as "City Balks at Surcharge on Water Bills," "City Ducks Blame for Water Bills," and "Delay Is Seen on Surcharge Water Rate." The commission's proposal for a 60 per cent surcharge was finally cut to 35 per cent at the suggestion of the Water and Sewer Board. Surprisingly, during the heated discussions on the surcharge and the water rate increase, on July 10, 1950, the commission voted three to two in favor of the 14 per cent water rate increase

Increase in Revenue

The new rate does not change the minimum bill of $3.75 per quarter but does reduce the amount of water allowed from 2,700 to 1,800 cu ft. There was little or no complaining by the customers other than a few commercial ones, such as soft-drink bottling plants, laundries, and ice plants. People started to conserve water and the per capita consumption dropped. The yearly metered per capita consumption for 1949–50 was 150,604 gal; for 1950–51, 143,328 gal; and for 1951–52, 140,459 gal. It is believed, however, that the consumption trend will soon turn upward again.

During the twelve-month period ending in April 1952 the increase in gross revenues was approximately 14 per cent, but almost half of this increase is attributable to new customers. The average annual bill per metered customer rose during the first six months from $33.66 to $34.41 and at the end of twelve months to $35.98, or a total increase of 6.9 per cent.

Chlorine Controls Revoked

Revocation of the NPA chlorine control order, M-31, on November 18, 1952, eliminated delivery provisions and percentage ceilings on chlorine. The order was issued January 23, 1951, to assure chlorine supplies for public health needs and distribute defense orders equitably among chlorine producers. According to Thomas C. Keeling Jr., Director of the Chemical Div. of National Production Authority, chlorine production has been adequate to meet the demand for the past six months. Chlorine is not stored in quantity, and production is virtually equivalent to demand. At present, production is less than available capacity, and no increase in military demand is anticipated.

Slurry Feeding of Activated Carbon

By John R. Baylis

A paper presented on May 5, 1952, at the Annual Conference, Kansas City, Mo., by John R. Baylis, Engr. of Water Purif., Bureau of Eng., Chicago.

IN order to provide a cheaper and more practical method of handling powdered activated carbon, the Chicago South Dist. Filtration Plant began experimenting in 1948 with the shipment of the material in bulk in hopper-dump railroad cars, unloading into tanks, and wetting and applying to the water in a slurry form. Instead of constructing sufficient equipment for handling all of the powdered carbon in this manner, it was decided best to construct only two tanks. Six additional tanks will be required to handle almost all of the carbon used in the plant in the slurry form.

Feeding Problems

When the filtration plant was designed, a good means of handling powdered carbon had not been devised. Rather than construct costly equipment that might not meet the need, it was decided to install dry-feed machines and dump the carbon by hand from bags into weighing hoppers above the machines, and then work out, by trial with plant-size equipment, a practical method that could be extended to cover the entire needs of the plant. Thus, the plant was placed in operation with nine dry-feed machines and nine hoppers for dumping the bags of carbon, which were stored on the floor of the chemical building.

Table 1 gives the yearly use of activated carbon, the maximum daily usage, and the percentage of material handled in bulk since the plant was placed in operation. The South Dist. Plant uses more powdered activated carbon than any other filtration plant, though not in terms of pounds per million gallons.

Although the dry-feed machines each had a guaranteed capacity of 600 lb per hour, it was never possible to operate at this rate. The material floods at frequent intervals and spills on the floor before the maximum rate is reached. During severe odor periods it was generally necessary to dump some of the carbon directly from bags into the water in the rapid-mixing basins to supplement that added by the machines. As a result, there was a thick layer of carbon dust over most of the lower floor of the chemical building, the places for dumping by hand being outside the enclosures of the carbon dry-feed machines.

The flooding of the carbon machines generally kept the floor inside the rooms enclosing the machines covered with carbon. Every available employee was doing his utmost to keep the right amount of carbon going into the water. Usually the odor threshold, during severe periods of pollution, was reduced below the objectionable point. The plant personnel were proud of this achievement but regretted the unsightly appearance of the chemical building.

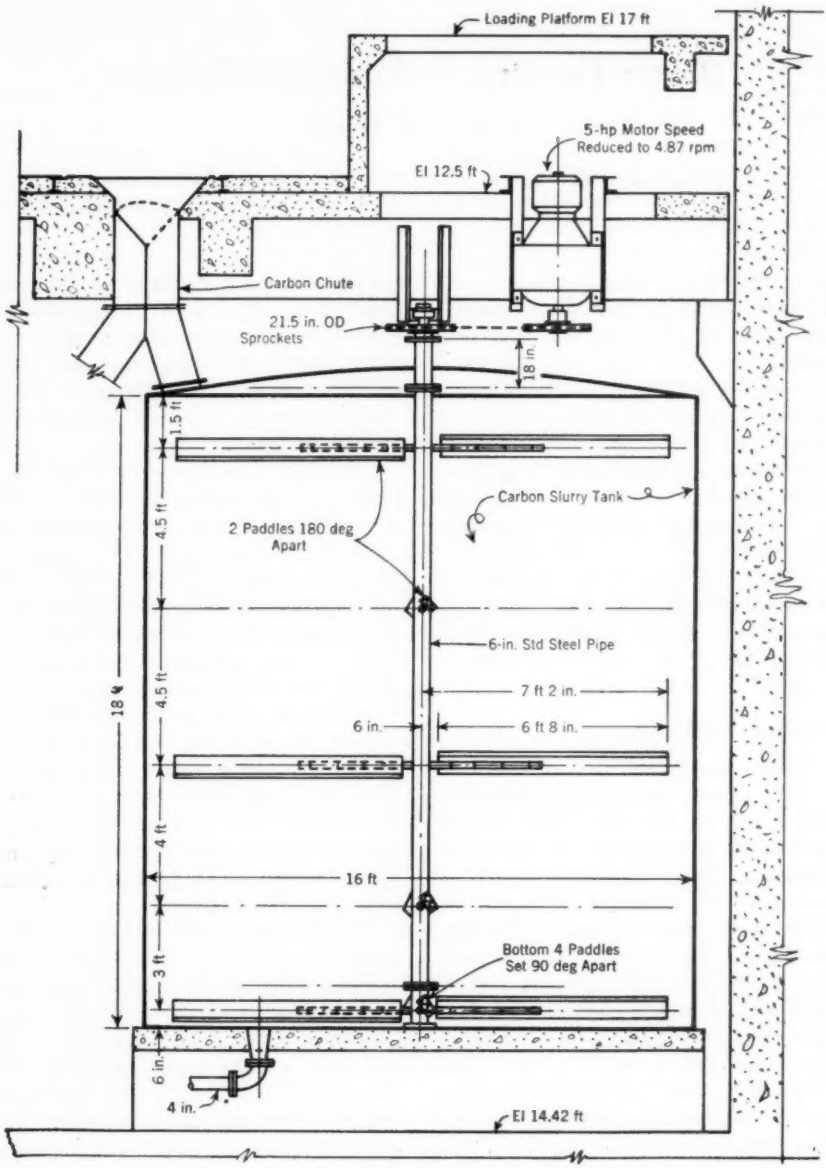

Fig. 1. Steel Tank Equipped With Paddle Agitation

Tank is 16 ft in diameter and 18 ft in depth, and has a total capacity of 27,000 gal.

TABLE 1

Powdered Activated Carbon Usage

Year	Total Carbon Used *lb*	Carbon Used, Max. Day *lb*	Avg. Usage *lb/mil gal*	Carbon Shipped in Bulk *per cent*
1947	2,138,082	19,329	17.9	
1948	2,807,980	84,842	24.0	
1949	3,429,993	45,897	30.6	18
1950	2,867,329	63,409	25.5	42
1951	3,545,552	76,362	30.7	38

A yearly total of 1,400–1,750 tons of activated carbon is a large amount of material to be handled in 35-lb bags, as all of it was at first. This amount—1,750 tons—necessitated the handling of 100,000 35-lb bags, or a daily average of 275 bags. A total of 84,800 lb, or 2,423 bags, of carbon was used on Feb. 18, 1948. In addition to the enormous labor of dumpings the bags, burning the empty ones was a considerable task. During periods of heavy carbon feed, there was so much carbon on the floor that the obvious waste became a matter for consideration. The unsightly appearance of the chemical building during periods of heavy use of activated carbon was also a major factor in hastening the trial of some other means of handling this material.

Slurry Handling Equipment

F. G. Gordon, assistant city engineer in charge of filtration designs, began to consider slurry handling of carbon in 1946. The design of equipment for bulk shipment and for handling the material at the plant in the slurry form was completed in 1947. The first two units were placed in service in August 1948. A 90-gpm recirculating pump having an ejector for keeping the carbon in suspension was the first design. The pump agitation did not maintain a slurry of uniform strength. A compressed-air installation helped, but did not effect complete mixing. Paddles attached to a vertical shaft in the center of the tank were tried next.

The handling of carbon in the slurry form was not given consideration when the chemical building was designed, so that not nearly enough space was available. Some features of the design were necessitated primarily by space requirements and do not represent the most ideal layout.

Steel tanks were used for the first two units, because they fitted the space more readily than concrete tanks. At that time circular tanks were considered the best shape. Square tanks would best fit the construction of the Central Dist. Filtration Plant, and, in order to provide information on this shape of tank, two square concrete tanks have been designed. Construction work on these tanks is just starting.

The west tank, as shown in Fig. 1, was the first to be equipped with paddle agitation. The tank is 16 ft in diameter and 18 ft in depth, and has a total capacity of 27,000 gal. The maximum working capacity is approximately 25,000 gal. The tank was equipped with paddle agitators, mostly from equipment already on hand, and was placed in operation in May 1949. The agitator shaft was made of 6-in.

heavy steel pipe and was built in two sections in order to get it inside the tank. Until a vertical motor and reducer could be purchased, a horizontal drive, set on end, was used.

A four-paddle agitator was set with the center of the paddles 6 in. above the bottom of the tank. The paddles were supported by 2-in. extra-heavy steel pipe which passed through the pipe shaft. Four two-blade agitators were spaced 3, 7, 11½, and 16 ft from the bottom of the tank.

The purpose of the agitators was to provide slow-speed agitation to cover almost the entire area and depth of the tank. As the water level in the tank falls, the upper paddles revolve above the slurry and add nothing to the agitation. This arrangement produces almost uniform agitation of the mixture as the depth becomes less on feeding the material from the tank.

High-speed agitation with blades near the bottom of the tank could have been used, but power requirements would probably have been greater. It was also feared that the tank was too deep for such agitation to be uniform throughout the mass. Agitators powerful enough to mix the full tank thoroughly may create quite a stir in the material when the tank is almost empty. The author recalls previous experience with both square and round tanks using high-speed agitation at the bottom. A change was later made in the square tanks to long-blade, low-speed agitators and the results greatly improved. The tanks were 16 ft in depth, and probably 10 × 10 ft, or a little larger, in size.

Slurry Tanks

As stated, the space available for tank construction imposed limitations on the present design. The head room was low and the tank diameter was limited. The tanks are set on a concrete platform located 3 ft above the main floor of the basement in order to provide space for piping connections through the bottom of the tanks. Paddle agitation made it possible to set the tanks relatively low, thus providing some much-needed room at the top.

The last inch of the slurry from the tank cannot be used, and practical operation requires that at least 6 in. be left in the tank. Thus, 24,000 gal of renewed slurry added to a tank gives a depth of 16½ ft, which would leave 1½ ft of space at the top of the tank.

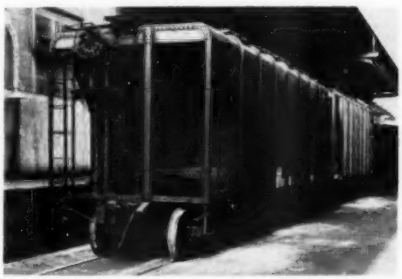

Fig. 2. Carload of Bulk Carbon in Position for Unloading

The two gates at one end of the car are spotted over the chutes leading to the tanks. The contents of the entire car are dumped into one tank.

Circular tanks produce circular motion of the water. Usually very good mixing can be obtained and it is not necessary to use obstructions to increase the violence of the agitation. Obstructions can be added, however, if it seems advantageous. An obstruction has been placed in the west tank of the South Dist. Filtration Plant, but it does not seem to contribute much. In general, agitation provided for the west carbon tank is satisfactory, although compressed air is required to loosen compact carbon at the bottom of the tank before agitation is applied.

The east carbon tank was equipped with paddle agitators during the latter part of 1949. The design is like that of the west tank, except that an extra-heavy, 8-in. pipe was used for the shaft. Also, the four-paddle agitator at the bottom of the tank was changed to two two-blade agitators, the lower blades of which were 7½ in. from the bottom of the tank. A second two-paddle agitator was placed 6 in. above these agitators. Additional two-paddle agitators are located 4½, 8½, 12½, and 16½ ft above the bottom of the tank. The bottom paddles are 3 × 8-in. cypress boards 7 ft 4¼ in. in length, fastened to 2-in., extra-heavy steel pipe crossarms that pass through and are welded to the pipe shaft. The blades on the upper agitators are 3 × 6-in. cypress boards, 6 ft 8¾ in. in length. All of the 2-in. pipe crossarms are 10½ ft in length.

Because of the difficulty in getting the pipe shaft into the tank, it was made in five sections. The shaft is driven at a speed of 4 rpm by a 5-hp motor and double-worm reducing unit. This type of drive was later placed in the west tank. The shaft is held at the bottom with a pivot pin fastened to the bottom of the tank. A thrust bearing at the top holds the weight of the shaft and paddles.

A coal-tar enamel * was used to coat all metal surfaces inside the tank. Repainting or touching up of spots is required at frequent intervals. Activated carbon corrodes metal such as steel and wrought iron very rapidly, and it is necessary to keep the metal coated. This corrosion alone is causing consideration of nonmetallic materials for the other tanks.

* Bitumastic, a product of Koppers Co., Pittsburgh, Pa., was used.

Bulk Shipment

Most of the carbon is shipped in bulk in four-section hopper-dump cars that hold approximately 27,000 lb of carbon, although occasionally the weight is greater. For unloading, the two gates at one end of the car are spotted over the chutes leading to the tanks. An adapter of canvas with metal frames is used to prevent dusting. The contents of the entire car are dumped into one tank. Figure 2 shows a car in position, ready for unloading. Figure 3 shows the canvas connectors in place. When ready to unload, the two gates are opened and the electric vibrators are started. Generally the carbon unloads very well, although an occasional poking with a rod loosens the carbon and produces more rapid discharge. After carbon is discharged from the two hoppers, the adapter is loosened, and the car is pushed forward until the two rear gates are in position over the chutes. The adapter is fastened and this part of the car is ready for unloading.

Fig. 3. Canvas Connectors From Car to Tank

Wetting Carbon

Considerable thought was given to the best means of wetting activated carbon before installing the paddle agitators. Bags of carbon were dumped into the tanks to determine the length of time required for the carbon to wet. The process of dumping the bags was so slow that not much information was obtained. The next effort was to dump carbon from bags into one of the silica tanks which was located at a higher elevation in the chemical building. With the agitators turned on, the wetting did not take place as rapidly as the rate of dumping. A large amount of dry carbon floated at the top. Trials were then made to see if the wetting rate could be increased. Wetting the carbon from the top with a hose and then a spray was tried. This procedure seemed to retard rather than hasten the wetting period.

There were indications that the best procedure would be to dump the carbon on top of the water and allow it to wet without agitation. This procedure was followed in the main carbon slurry tanks. A tank is filled with 6–8 ft of water and the unloading is started. All of the material from half of the car is run into the tank. Usually half the car is emptied one day and the other half the following day. The elevation of the dry material in the tank is 15–18 ft from the tank bottom. The surface level of dry material drops gradually as the carbon wets, and from time to time additional water is added. The wetting time for the material received in hopper-dump cars from the Covington, W.Va., activated-carbon plant has averaged approximately four days. Table 2 gives the time required for wetting the carbon.

The carbon manufacturer recently moved the equipment for filling hopper-dump cars from Covington, W.Va., to Luke, Md. Material from this plant is much more difficult to wet. A period of four days for wetting does not interfere appreciably with filter plant operations. After all of the slurry handling equipment has been installed, however, a period of fifteen to twenty days will be entirely too long for practical operation. If material that wets faster than that cannot be obtained, some other means of hastening the wetting must be sought. Violent agitation may have to be used.

TABLE 2

Summary of Activated Carbon Wetting-Down Periods

No. of Days for Wetting Down	No. of Hopper Cars	Percentage of Total Cars
2	6	5.2
3	26	22.6
4	40	34.8
5	30	26.0
6	7	6.1
7	2	1.7
12	1	0.9
14	1	0.9
17	1	0.9
22	1	0.9
Total	115	100.0

No explanation for the much more rapid wetting of one material than the other can be offered. The trouble seems to be caused by air that becomes trapped in the carbon and prevents the carbon from settling to the bottom of the tank after it has become wet. After floating on the water for several days, the layer of wet carbon should drop so that the water can get to the dry material more easily. If some form of agitation can be provided to cause the carbon, as it becomes wet, to break loose from the dry material

above, the rate of wetting should be much more rapid. The long-paddle agitator cannot be used so long as dry carbon covers the top agitator.

As stated previously, work is getting under way on the construction of two nearly square concrete tanks having inside dimensions of 14 ft 7 in. by 14 ft. After the tanks are completed, various kinds of agitation equipment will be tried. If the present long-paddle agitation is not satisfactory, some form of high-speed agitation will be tested.

The idea of handling carbon in the slurry form should not be abandoned, for once the carbon is wet, no more difficulty in handling the material is anticipated. Although a little dry carbon is carried forward to the mixing basins from the present dry-feed machines, most of it becomes wet within a few seconds in passing through the receiving hopper at the dry-feed machines and a water ejector that pushes the mixture forward through piping to the mixing basin. The length of travel in the piping is from 24 to 109 ft. During periods when carbon usage is high, a small amount of the material does not become wet and there may be a little floating material on top of the water in the mixing basins. In general, however, the wetting is quite rapid and shows that agitation, properly applied, can be successful.

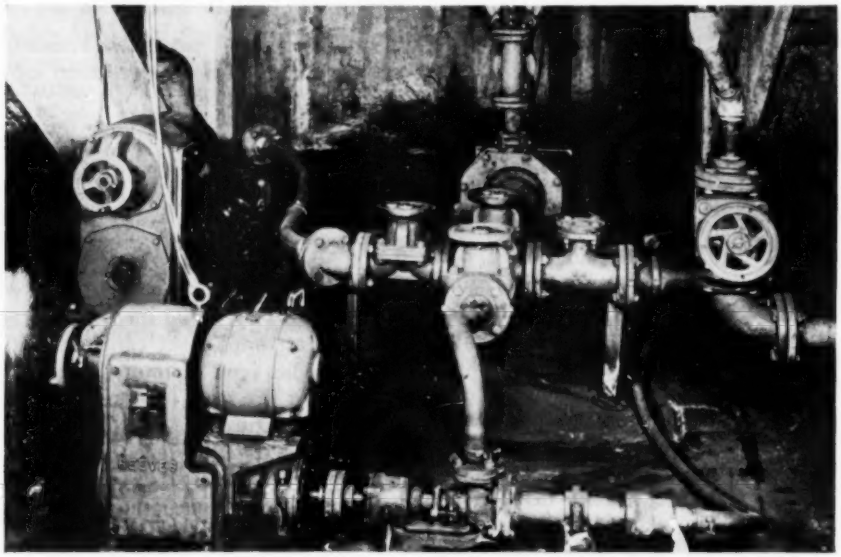

Fig. 4. Pumps and Piping Connections for Slurry Feeding

The slurry is pumped up to a feeding device on the main chemical building floor where the flow is split into three streams by weirs of equal elevation.

Slurry Concentration

Laboratory experiments indicated that a slurry containing 1.25 lb per gallon was sufficiently liquid to be pumped through the feeding pipes. Experience indicates that a mixture of 1.0 lb per gallon is more easily handled. When the carload shipments

contain a little less than 30,000 lb, it is possible to maintain mixtures near this concentration.

Rubber-lined pumps were first tried to pump the carbon slurry from the tanks to the point at which it is fed into the water being treated. The rubber lining deteriorated very quickly, however, and it was necessary to try something else. A small Moyno * pump was then tried. This pump, with a metal rotor and a rubber stator, has a maximum capacity of approximately 6 gpm of slurry. The pump is provided with a variable-speed drive.† Slurry is pumped up to a feeding device on the main chemical building floor where weirs of equal elevation split the flow into three streams. Figure 4 shows pumps and piping connections.

The slurry from the weir box discharges into three feeding pipes that carry it to the three mixing basins. Additional water is added so that the strength of the slurry is greatly diluted from this point to the mixing basins. This dilution avoids clogging in the feeding line. Another Moyno pump with a capacity of approximately 25 gpm was installed. These two pumps meet the ordinary demand for carbon in the plant. If greater capacity is required, a rubber-lined, centrifugal pump with a capacity of 50 ppm is available. This pump is used as little as possible to avoid wear.

The rotor in the Moyno pump was at first worn by abrasion of the slurry. Stainless steel is now used and very good service is being obtained. The exact life of the stainless-steel rotor is not known. The rubber stator in the pumps has to be changed occasionally. The stainless steel lasts long enough, however, so that it does not present an expensive maintenance item.

Rubber-lined pipe and rubber hose are the best materials to use for carbon slurry. Such materials have given good service at the South Dist. plant. Rubber hose is used for the discharge of the two Moyno pumps and rubber-lined pipes are used for the discharge of the centrifugal pump. Part of the suction line is also rubber hose.

Summary

1. Shipment of powdered activated carbon in bulk in hopper-dump cars has proved practical.

2. The practice of unloading the carbon from the cars into a tank of water, and, after the carbon has become wet, making it into a slurry by mechanical agitation, is a satisfactory means of handling the carbon.

3. Dumping from bags into dry-feed machines is costly, and the carbon dust presents an unpleasant condition.

4. Paddle type agitators and compressed air are used for maintaining a uniform mixture. Agitators are located at five different levels in the tank.

5. Circular steel tanks are used. Difficulty is experienced in maintaining a protective coating inside the tanks.

6. The carbon is shipped in hopper-dump cars holding 27,000 to 30,000 lb each.

7. Most of the carbon becomes wet in three to five days. Several carloads received from a different plant have been much slower in wetting.

8. Two square-shaped concrete tanks for additional capacity are under construction.

9. The slurry mixtures should not exceed 1.25 lb per gallon; 1.0 lb per gallon is a better concentration.

10. The Moyno pump has proved practical for pumping carbon slurry.

* The Moyno pump is a product of Robbins and Myers, Inc., Springfield, Ohio.

† The drive is a product of the Reeves Pulley Co., Columbus, Ind.

Control of Fluoridation

By Robert S. Jacobson

A paper presented on Oct. 4, 1951, at the West Virginia Section Meeting, Charleston, W.Va., by Robert S. Jacobson, Asst. Engr., State Dept. of Health, Charleston, W.Va.

THE medical, dental, and engineering professions recognize that the proper control of the quantity of fluoride in public water supplies is of vital importance. When the laboratory control of any water treatment process is considered, such factors as the availability of personnel and facilities and the importance of control must be emphasized. These factors make it impossible to set down one method of control for all fluoridation installations.

In 1936 the American Water Works Assn. appointed a committee to make a careful study of methods for the determination of fluoride that appeared to hold promise. A year was spent in deciding what methods should be used. Then, with the cooperation of ten laboratories located in different parts of the country, 174 1-gal. samples from 22 different sources were submitted to these laboratories. All of these sources of water were known to contain fluoride in concentrations from 0.10 to 14.0 ppm. The laboratories ran the samples by the methods previously agreed upon and reported the results to the committee. The final committee report (1) indicates excellent comparative results from all ten laboratories. Although these procedures were suitable for a well-equipped laboratory, it is felt that they left much to be desired as methods for the routine determination of fluoride in water plants.

Methods

For many years chemists have been working on the quantitative analysis of fluoride in water. A few of the many methods (2) that have been proposed and tried include:

1. Etching methods in which comparative tests are made on the action of liberated hydrofluoric acid on glass or quartz.

2. Gravimetric methods by which the fluoride is precipitated and weighed as calcium fluoride.

3. Volumetric methods by which the fluoride is converted to silicon tetrafluoride or hydrofluosilicic acid and is titrated with a standard base or with a solution of a metallic salt, such as thorium nitrate, which, by reacting with a suitable indicator, will produce a color change when the endpoint is reached.

4. Colorimetric procedures in which comparisons of the color changes produced by different amounts of fluoride in the presence of certain indicators are made.

5. Spectrometric procedures in which the dry residue, after evaporation in the presence of calcium, is placed in the anode of a carbon arc. (Time required for the calcium fluoride band to disappear, under proper conditions of excitation, is proportional to amount of fluoride present.)

6. Potentiometric procedures which involve a volumetric precipitation of fluoride as cerium trifluoride and a new application of the ferri-ferrocyanide electrode.

7. Microchemical procedures by which the number of sodium fluosilicate crystals formed under standardized conditions is counted.

Another scheme involves a comparison of the results of histological examinations of the teeth of aquatic animals that have been exposed for some time to the water in question and of control animals that have lived in fluoride-free waters. Of these methods, only the volumetric and colorimetric methods appear to be applicable to the routine analysis of water.

Colorimetric Methods

The most familiar of the colorimetric methods to the water works man is the chlorine residual determination using orthotolidine. The determination is possible because orthotolidine, in the presence of chlorine, will turn yellow in proportion to the quantity of chlorine at concentrations commonly employed in domestic water supplies. The colorimetric determination of fluorine is not so simple because there is no known compound that will take on the fluoride ion and develop a color that is proportional to the fluoride concentration.

The generally accepted procedure for the colorimetric determination of fluoride is based on the principle of the bleaching of the color of a preformed lake. A lake is an insoluble metallic compound of dye that is formed when a dye reacts with hydroxides or basic salts of metals, such as zirconium, aluminum, chromium, tin, or iron.

The zirconium-alizarin lake is the most commonly used lake for fluoride analysis. The lake is introduced into the unknown sample in the ratio of 1 part of lake to 10–20 parts of sample. The fluoride present has the property of bleaching the red color of the lake in proportion to the quantity of fluoride present. By comparison with standards of known fluoride concentration, the quantity of fluoride may be obtained. If Nessler tubes or French square bottles are used for comparison, an adequately lighted comparator should be used. The intensity of color given the solution by the lake and the fluoride bleaching of the lake make viewing of the samples and standards difficult.

Interfering Substances

The simplicity of the determination is evident, but such factors as age of the indicator, temperature, time elapsed before comparison is made, and interfering compounds and ions, of which there are many, may cause an increase or decrease in the bleaching of the lake, and therefore give a false reading. The problem of interfering substances seems to be minor when the chemical characteristics of the source of water do not change materially. Some difficulty may be encountered in analyzing water of surface origin. Two of the fluoridation installations in West Virginia take water from a river that is grossly polluted with industrial and domestic wastes. The chemical characteristics of this water are so variable that special steps must be taken to eliminate the possibility of interference.

The one interfering substance that can be expected in practically all public water supplies is chlorine. This

interfering substance can be eliminated, however, by dechlorinating the sample with a bare excess of sodium thiosulfate or sodium arsenite before adding the lake. It has also been found that evaporation to dryness and redissolving with distilled water will effectively remove chlorine and other dissolved gases which may cause interference. Comparative results have been obtained by using all three of these methods for dechlorination purposes. If chlorine dioxide is used for sterilization, dechlorination may be accomplished effectively using any one of these methods. It can be said, therefore, that dechlorination by evaporation is not justified unless some other gas or gases are present which may be removed by this procedure.

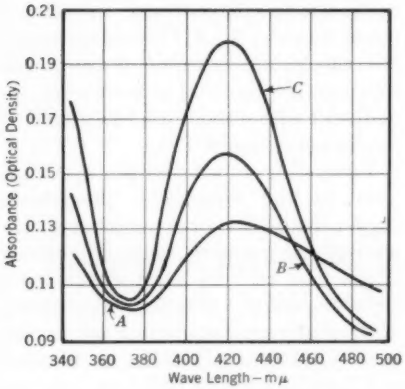

Fig. 1. Absorbance of Different Quantities of Fluoride

Curve A *represents no fluoride, Curve* B *0.7 ppm fluoride, and Curve* C *1.3 ppm fluoride.*

It has been found that combined chlorine residuals of less than 0.2 ppm do not interfere, but if the combined readings are more than 0.2 ppm and if there is any free chlorine residual, interference will result. When samples reach the laboratory for the routine checking of fluoridation, they are diluted with an equal volume of distilled water. When most of the public water supplies in West Virginia are diluted, the combined chlorine residual is decreased to less than 0.2 ppm and dechlorination is eliminated. This dilution process also has the advantages of placing the fluorine concentration between 0.4 and 0.7 ppm, which is much easier to read when using an alizarin lake and Nessler or French square bottle comparison, and reducing the concentration of any interfering substance by half.

There are, of course, many other interfering substances and ions. These substances and the methods of handling them will not be discussed; however, if the characteristics of a given water are unfamiliar, the safest way to assure accurate results is to distill the sample as directed in *Standard Methods* (3).

Spectrophotometric Methods

Considerable effort has been made to adapt the spectrophotometer to the routine analysis of fluoride by the zirconium-alizarin lake procedure. As previously pointed out, a lake is a suspension and as such in photometric analysis, it falls under the heading of turbidimetry, which is the measurement of the light absorbed by a suspension (4, p. 69). The absorption–wave length curve, Fig. 1, indicates a good absorption differential at 420 mμ. The density-concentration curves obtained when running knowns at 420 mμ, however, are inconsistent. The chief difficulty appears to lie in obtaining reproducible suspensions. Sil-

ver and magnesium (4, pp. 307, 402) have been determined spectrophotometrically using lakes and it would seem that fluoride could be determined by the same method. When and if a spectrophotometric procedure is developed for fluorine, routine control work will be materially simplified.*

Another colorimetric procedure, which is based on the bleaching of an aluminum lake of Eriochrome cyanine RC, was developed recently by the late W. E. Thrun (6). This procedure appears to hold promise for spectrophotometric analysis. It has the advantage of completed color change (bleach) in 10 min when most other lakes require at least 1 hr.

One of the oldest colorimetric methods for fluoride (7) is the oxidizing of a titanium solution with hydrogen peroxide to form a yellow color. Fluoride also has the property of bleaching this yellow color, and does so in proportion to the quantity of fluoride present. There is also some possibility that this method may be suitable for photometric analysis.

Volumetric Methods

The volumetric procedure most common to the water works man is the alkalinity determination. This type of determination involves the addition of a standard solution to an unknown solution containing an indicator that will show a change of color at the endpoint. Generally speaking, volumetric procedures are not suitable for determinations at the low concentrations practiced in fluoridation.

The most common volumetric procedure for fluoride is titration with thorium nitrate using alizarin red as the indicator. This indicator gives a very vague endpoint difficult to determine with the naked eye. The procedure for the determination of fluoride given in the *Official Methods of Analysis* (8) requires a double titration, first with thorium nitrate and then with standard fluoride solution. Alizarin red is used as the indicator. A method using morin (2′,3,4′,5,7-pentahydroxyflavone) as the indicator, titrating with thorium nitrate, and determining the endpoint with a modified Fluorimeter * shows good results (9).

Interfering substances are also common in the volumetric procedures. Again, distillation or some other special method of handling must be utilized. There has recently been developed a high-frequency titration instrument (10) that may have some application to a volumetric procedure for fluoride.

Summary

The proper control of fluoridation is of unquestionable importance. Recognizing the limitations of all known laboratory procedures, a daily record of the number of gallons of water treated and the total number of pounds of fluoride compound added should be kept at all fluoridation installations. These results should be recorded with the daily laboratory analyses for fluoride.

References

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* Subsequent to the writing of this paper, a spectrophotometric procedure for fluoride was reported by Megregian and Maier (5). This procedure contains nothing basically new and the factor of interfering substances remains an obstacle. It is felt, however, that this work is an important contribution to the field.

* A product of the Klett Mfg. Co., New York.

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Revision of Reinforced Concrete Pipe Specifications

By action of the AWWA Board of Directors on June 13, 1952, extensive changes have been made in the text of specifications AWWA C300, "Specifications for Reinforced Concrete Water Pipe—Steel Cylinder Type, Not Prestressed," and also AWWA C301, "Specifications for Reinforced Concrete Water Pipe—Steel Cylinder Type, Prestressed." At the same time, the documents were advanced from "Tentative" to "Standard" status.

The revisions, which are too extensive to summarize, were intended to take advantage of experience with the tentative specifications, and to take into account recent developments. Copies of the revised texts of AWWA C300 and C301 may be obtained from Association headquarters at a cost of 25¢ each.

Binding the Year's Journals

Through the cooperation of the Library Binding Institute, an organization of binderies which specializes in binding publications into volumes, arrangements have been made to give information and assistance to A.W.W.A. members who want to have their JOURNALS bound. This work may be done in accordance with standards of materials and construction required for durability, service and accessibility by college, reference, and public libraries. The American Library Association and the Library Binding Institute have cooperated in promulgating "Minimum Specifications for Class A Library Binding" based on research and production and performance experience.

A committee of the American Library Association has certified responsible and reliable library binderies which have proved able to meet these specifications. To obtain standard quality binding, simply request Class A binding at any certified bindery. In obtaining price quotations, state the three dimensions of the volume.

Names and addresses of certified binderies in your area are available from the Library Binding Institute, 501 Fifth Avenue, New York 17, N.Y. Before sending copies to the bindery:

1. Check for missing issues and check each issue for defects, missing pages, etc. Be sure to include the volume index.

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3. Write out definite instructions giving your preferences on the following points:

a. Color of binding (one of the following standard colors should be selected: dark green, dark blue, black, brown, or medium red).

b. Whether the advertising sections and/or paper covers are to be bound into the volume.

c. An exact copy of the text to be lettered in gold on the backbone. A common form is:

Journal—1¾ in. from top	Vol. 44—4¼ in. from bottom
AWWA—2¼ in. from top	1952—3¾ in. from bottom

d. If you have had JOURNALS bound before and want your set to match as closely as possible, send a previous volume as a sample. If you want an approximate match, send a "rubbing" of the lettering on a previous volume and indicate the color.

If satisfactory arrangements cannot be made, or if there is any difficulty, advise the AWWA office and steps will be taken in cooperation with the Library Binding Institute to assure you proper service.

By arrangement with AWWA, University Microfilms, 313 N. First St., Ann Arbor, Mich., is making a microfilm edition of the JOURNAL available to regular subscribers at a price comparable with the cost of library binding. The cost of the 1951 volume was $6.25.

1952 Conference—Kansas City

KC '52 was the symbol of the seventy-second and second largest annual conference of AWWA, held last May 4–9 at Kansas City, Mo.—KC '52, that is, and steak. But even between steaks the week was a full one—full of sixteen tiptop technical sessions; more than two dozen committee, section, and other official meetings; daily inspection trips to both the Missouri and Kansas KC plants; western whoop-de-do of one kind or another at least every evening; and constant supermarketing at 145 booths which featured the latest and greatest in what makes water works work. Center of all these attractions was the Municipal Auditorium, which housed just about everything (except the ladies' events and the golf tournament) and housed them as efficiently as most of those in attendance housed their steaks.

Riding herd on the whole shebang was the Convention Management Committee, chairmanned by Tom Veatch and including:

Representing AWWA	*Representing WSWMA*
Melvin P. Hatcher	T. T. Quigley
Robert S. Millar	E. A. Sigworth

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Harry E. Jordan, *Secretary*	John G. Stewart, *Manager*
C. H. Capen, *Chm., Publication Com.*	

Having corralled some 90 head of speaking talent, technical program boss Charlie Capen made even the work of the week fun. What kind of fun and whose are listed on pages 1182–84. What was written has been published in the JOURNAL from then till now; what was spontaneous and unrehearsed is gone but not forgotten by those there. And spurred on by everything from rainmaking to flood control, water hammer to molecular filter membranes, everyone got into the act and got something out of it.

Making work fun, too, was John Stewart's Exhibit Committee, which set up 87 manufacturers in some 15,000 sq ft of business in the sunken arena of the Municipal Auditorium. There it was that equipment in action told its own story of water works progress, and there it was that superintendents and managers made up their Christmas lists for town councils or boards of directors back home.

Finally, really working to make fun for everyone were Tom Quigley and his General Entertainment Committee, who made capital of the fact that Kansas City is "where the West begins." Starting the week in cowpoke cloak, they built up

1952 CONFERENCE STATISTICS

Kansas City Registration by Days

Day	Men	Ladies	Total
Sunday, May 4	814	248	1,062
Monday, May 5	558	123	681
Tuesday, May 6	112	15	127
Wednesday, May 7	67	—	67
Thursday, May 8	49	—	49
TOTALS	**1,600**	**386**	**1,986**

Geographic Distribution of Registrants

UNITED STATES & TERRITORIES

Alabama	31	Maine	2	South Dakota	10
Arizona	10	Maryland	15	Tennessee	42
Arkansas	16	Massachusetts	18	Texas	71
California	87	Michigan	41	Utah	2
Colorado	35	Minnesota	37	Vermont	1
Connecticut	11	Mississippi	6	Virginia	16
Delaware	5	Missouri	270	Washington	5
Dist. Columbia	16	Montana	3	West Virginia	9
Florida	30	Nebraska	28	Wisconsin	50
Georgia	26	New Jersey	96		
Hawaii	2	New York	147		
Illinois	177	North Carolina	19		
Indiana	44	North Dakota	5		
Iowa	78	Ohio	84		
Kansas	127	Oklahoma	52		
Kentucky	18	Oregon	5		
Louisiana	35	Pennsylvania	133		
		Puerto Rico	1		
		Rhode Island	21		
		South Carolina	15		

CANADA, CUBA & FOREIGN

Canada	26
Cuba	3
Dominican Republic	2
Japan	2
TOTAL	**1,986**

Comparative Registration Totals—1943–1952

Year	Place	Men	Ladies	Total
1952	Kansas City	1,600	386	1,986
1951	Miami	1,415	491	1,906
1950	Philadelphia	1,678	329	2,007
1949	Chicago	1,593	374	1,967
1948	Atlantic City	1,348	356	1,704
1947	San Francisco	1,115	431	1,546
1946	St. Louis	1,303	214	1,517
1944	Milwaukee	1,185	171	1,356
1943	Cleveland	973	158	1,131

Win, Place & Show in Section Awards

Henshaw Cup		Hill Cup		Old Oaken Bucket	
Cuban	**80.0%**	**Kansas**	**49.95**	**California**	**989**
W.Va.	58.5%	Indiana	36.42	New York	699
Ala.-Miss.	57.7%	Florida	32.30	Southwest	670

through an evening of meeting and greeting and another of reception and awards to the Cow Town Jamboree, which capped the week's informalities with a ten-gallon hat. A quiet evening of watching "The River" then made way for the Thursday banquet that climaxed another year of AWWA accomplishment and association. Meanwhile the ladies spent every day, as well, at fun under the watchful eye of ladies' chairman Mrs. Mel Hatcher.

Not to be forgotten in calling the roll, either, were Sig Sigworth's Transportation Committee and the hundreds of Missouri and Kansas water workers and wives who hosted and hostessed in real western style. Tom Veatch, Mel Hatcher, and Bob Millar have already been mentioned, and adding to the list such busybodies as Ellsworth Filby, Garvin Dyer, Jim Ramsey, and Eric Bacharach, who were responsible for local coordination of convention management details, only begins to suggest the number of cooks it took to broil, not spoil, KC '52.

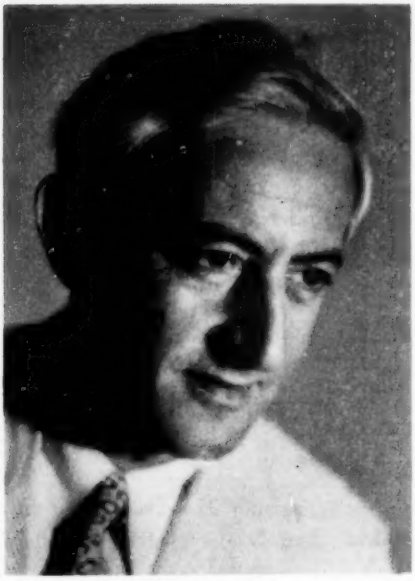
Association Awards

Honorary Membership was conferred upon Norman J. Howard, of Toronto, Ont.; Howard S. Morse, of Indianapolis, Ind.; and N. T. Veatch, of Kansas City, Mo. The citations follow:

NORMAN J. HOWARD, Director of Water Purification, Toronto, Ont.; a member of the Association since 1920; Chairman, Canadian Section, 1931–32; Director, representing the Canadian Section, 1934–37; Vice-President of the Association 1940; President 1941; Fuller Award 1943; *internationally distinguished for his research in and practice of water purification; for many years the unselfish medical counselor of a group of people for whom professional medical services were not available.*

HOWARD S. MORSE, Retired General Manager, Indianapolis Water Company, Indianapolis, Ind.; a member of the Association since 1925; Chairman, Indiana Section, 1926–27; Director, representing the Indiana Section, 1930–31, 1933–36; *a distinguished leader, who combined an understanding of the public's interest in water service with an ability to inspire the personnel under his direction into an effective public utility.*

N. T. VEATCH, Senior Partner, Black and Veatch, Kansas City, Mo.; a member of the Association since 1915; Chairman, Missouri Valley Section, 1937–38; Director, representing the Missouri Valley Section, 1941–44; Vice-President of the Association 1947; President 1948; Fuller Award 1951; *the able leader of an active engineering organization devoted to the improvement of water supply service, always willing when called upon to serve the people through application of his professional knowledge to public problems.*



Abel Wolman

Harry E. Jordan

The
American Water Works Association
confers
The Harry E. Jordan Achievement Award
upon
Abel Wolman
for his distinguished service beyond the line of duty
to the state of Israel, as counselor in the development
of its water resources

Presented May 8, 1952

A. E. Berry
President

The Harry E. Jordan Achievement Award, conferred when some member of the Association has rendered distinguished service outside the line of duty and in the form of a public service, was presented to Abel Wolman, its first recipient. Part of the citation follows:

ABEL WOLMAN, endowed with a brilliant mind, indoctrinated with the highest ethical principles by his devoted parents, trained in the routines of analytical and objective thinking by his teachers, matured into an inspiring guide of those who follow his leadership, a first-generation citizen who is a living testament of the American way; since the beginnings of the Republic of Israel he has advised its leaders in their planning of water resources developments; he spent the summer of 1950 on a voluntary tour of study and advice to this new nation in the efforts to restore that land to its long-lost productive level; for this service, beyond the line of duty, he receives this new distinction from the Association.

The John M. Diven Medal, awarded to the member whose services to the water works field during the preceding year are deemed most outstanding, was presented to Ernest W. Whitlock. The citation follows:

ERNEST W. WHITLOCK, in recognition of his untiring efforts and effective leadership in coordinating the divergent views of his Committee on Reinforced Concrete Pipe toward the development of Standard Specifications for Concrete Pressure Pipe, thus contributing to the advancement of sound water works construction practices.

The John M. Goodell Award, granted for the best paper published in the JOURNAL during the past year, was conferred upon Joseph M. Sanchis and John C. Merrell Jr. The citation follows:

JOSEPH M. SANCHIS & JOHN C. MERRELL JR., for their paper entitled "Studies on Diatomaceous Earth Filtration," published in the July 1951 issue of the JOURNAL (Vol. 43, page 475); the paper presents an unbiased appraisal of diatomaceous earth filtration and the possibilities of its application to a large water supply system; the long-range importance of this subject is recognized and is receiving considerable attention throughout the country; the highly competent contribution that the authors have made in this field is of momentous value to the water works industry.

The George Warren Fuller Awards were presented to 25 men whose Sections had nominated them in the year beginning with the 1951 Annual Conference at Miami and ending with the opening of the 1952 Annual Conference at Kansas City. The awards—which are conferred for "distinguished service in the water supply field and in commemoration of the sound engineering skill, the brilliant diplomatic talent, and the constructive leadership of men in the Associ-

ation which characterized the life of George Warren Fuller"—went to the following list of awardees:

Arizona Section—GUY AUSTIN RHOADS: For honest, sincere, and efficient endeavor, and gentlemanly rectitude in the management of the municipal water system for the town of Safford, Ariz.

California Section—SAMUEL BROOKS MORRIS: For his extraordinary work in the development of the water supply industry; for his constant promotion of the welfare of all water works men; and for his great human understanding that makes him loved by all who know him.

Canadian Section—WALTER ELWOOD MACDONALD: For his high accomplishments as a water works administrator, and for his persistent and aggressive support of Section activities.

Chesapeake Section—ABEL WOLMAN: For his many contributions to the understanding of sanitation; and for his leadership in promotion of public health engineering throughout the world.

Cuban Section—ABEL FERNANDEZ Y SIMON: For the valuable contribution that his treatise on the Havana Aqueduct has made to water works literature; his constant service to the Section; and his dedication to the service of the people of Havana through advancement of their water supply.

Illinois Section—WILLIAM J. DOWNER: For his outstanding contributions toward improved water works construction and operating procedures in the state, effected by his unusual combination of a fine personality and sound engineering judgment.

Indiana Section—THOMAS JACQUELIN BURRIN: In recognition of the example he has set for operators of small water works in adapting the best operational and managerial practices to their use; and for his loyal and untiring participation in Indiana Section affairs over many years.

Iowa Section—JACK JONES HINMAN JR.: In recognition of his tireless efforts on behalf of the Association; and for his far-reaching contributions to the practice of water purification in the Americas, the Philippines, and the Far East.

Kansas Section—FREDERICK WILLIAM SIEKER: In recognition of more than a quarter century of unselfish service to his community, and his persistent and productive interest in the water works affairs of his state and Section.

Minnesota Section—ROSS ADAM THUMA: In recognition of his outstanding contributions in the field of water treatment, his deep interest and work in the promotion of the water school, and his years of service in the interest of the Minnesota Section.

Missouri Section—VANCE CHRISTOPHER LISCHER: For the originality and earnestness of his studies to improve the application of sound engineering principles to water works practices, for his willingness to share his knowledge with others, and for his helpful participation in Section affairs.

Montana Section—1951—JAMES ROBERT CORTESE: Because of his outstanding work toward the advancement of the Montana Section throughout its twenty-

six years of existence; and because of his ability to do a professional job of water works management in his community.

Montana Section—1952—JOHN WOTRING HALL: An engineer who has combined a pioneer spirit with service to many communities in the state through bringing to them water supply and other conveniences of modern living.

Nebraska Section—LORENZO DOW WRIGHT: In recognition of his distinguished service in the water supply field, and his intelligent management of the water supply works of his city.

New England Section—RICHARD HENRY ELLIS: In recognition of his service to the Section and his many contributions to the development and maintenance of high standards for water works materials and methods, both as a utility manager and as a representative of fire insurance companies.

New Jersey Section—RICHARD EVANSON BONYUN: For his outstanding service in the rehabilitation and continued operation of an important water supply of the state, and for his active participation in and contribution to the building up of the New Jersey Section.

New York Section—WALLACE TIFFANY MILLER: For his wholehearted services to the New York Section during his terms as Chairman and Director, and for his extraordinary aid and encouragement in the formation of water works operators' organizations throughout the state.

North Carolina Section—GEORGE SAMUEL MOORE: For his untiring efforts in membership promotion which three times won for him the Maffitt Membership Cup; and in recognition of his continuing valuable service to the Section in all its various offices.

Ohio Section—FERDINAND PETER FISCHER: For his many years of unselfish service to the Section as its Secretary and his reliable contributions to the improvement of water treatment procedure.

Pacific Northwest Section—FREDERICK DAVID JONES: In recognition of his valuable service in the development of the water system for the city of Spokane, and the leadership and cooperation he has given the Pacific Northwest Section.

Pennsylvania Section—EARLE PHILLIPS JOHNSON: For the genial, tactful, and devoted service which he has rendered the water works profession, and for his untiring efforts on behalf of the Association in his many years of service as Secretary-Treasurer of the Western Pennsylvania Section.

Southeastern Section—NATHAN MEREDITH DEJARNETTE: For his many years of effective participation in the affairs of the Association and the Section; his untiring efforts toward the improvement of water supply in Georgia; and his inspiring example and unremitting labor in training men in the field of water treatment.

Southwest Section—LLOYD CLAYTON BILLINGS: For his years of conscientious and distinguished service to the city of Dallas; for his active participation in the Texas Water Operators Licensing Program and editing of the Texas Manual for Water Operators; and for his cooperative activities in the Association's committee work.

Virginia Section—HERMAN WALKER SNIDOW: For the devoted and outstanding service that he has rendered with modesty to the Commonwealth of Virginia in the field of water supply and sanitation; and for his untiring efforts in promoting the Section.

Wisconsin Section—ALBERT ERNST HINTZ: For his more than thirty years of faithful service to the Oshkosh Water Works and his keen interest and untiring efforts in promoting the activities of the Wisconsin Section during that period.

The Nicholas S. Hill Jr. Cup, awarded annually to the Section making the largest weighted gain in membership, was presented to the Kansas Section, which scored 49.95 points.

The Henshaw Cup, awarded annually to the Section having the greatest percentage of its members present at the Section's annual meeting, went to the Cuban Section for its score of 80.0 per cent.

The Old Oaken Bucket, awarded to the largest Section in the Association, was won, as in the twelve preceding years, by the California Section.

Schedule of Conference Papers and Reports

Water Purification Division—10:00 A.M.—May 5, 1952

Committee Report—Open-Air Reservoirs.....Norman J. Howard, *Chairman*
Task Group Report—Instrumentation and Methods for Testing Radioactive Contamination in Water.....H. H. Gerstein, *Chairman*
A Study of So-called "Electrical Treatment" of Water for Boilers.....
Rolf Eliassen and H. H. Uhlig

Water Works Management Division—10:00 A.M.—May 5, 1952

An Experience Panel—Selling Rate Adjustments to the Citizens.....
Led by Leonard N. Thompson,
Morris S. Jones, J. Clark Keith, A. P. Kuranz,
Wendell R. LaDue, Alfred O. Norris, and C. F. Wertz
The Place of the Manufacturer in the Water Works Industry.....William J. Orchard
The Water Works Industry Needs a Safety Program.....George MacDonald

Water Purification Division—2:00 P.M.—May 5, 1952

Slurry Feeding of Activated Carbon.....John R. Baylis
A Flotation Process for Water Purification.....Samuel H. Hopper
The Application of Molecular Filter Membranes to Specific Problems in Water Analyses....
Alexander Goetz, R. H. Gilman, and A M Rawn

Water Works Management Division—2:00 P.M.—May 5, 1952

Getting Along With:
Mayors and Councils.....George W. Pate Sr.
Employees and Customers.....Robert S. Millar
A Boom Municipality.....Virgil Knowles
Panel Discussion—Meeting Flood Problems.....*Led by* L. P. Cookingham
Establishing Emergency Authority.....Melvin P. Hatcher
Notifying the Public.....Nathan S. Bubbis
Shutting off the Plant.....Uel Stephens
Emergency Water Supply.....Major C. Hagar
Restoring Service.....Frank E. Willey

General Session—1951 Kansas Flood—9:30 A.M.—May 6, 1952

What Happened? How Much Rain? How Much Stream Flow?.....N. T. Veatch
Interruptions to Water Service:
Quality and Treatment.....Dwight F. Metzler and Russell L. Culp
Production and Distribution.....R. G. Kincaid
What of the Future?.....Arthur Carhart

Water Purification Division—2:00 P.M.—May 6, 1952

An Improved Design for Rapid Sand Filters.....Thomas M. Riddick
The New Insecticides and Their Effect on Water Quality.....Louis F. Warrick
Panel Discussion—Taste and Odor Problems During Spring Runoff.....J. F. Erdei, George S. Lee, Leo Louis Jr., Marcus P. Powell, and James Sampson

Transmission and Distribution Division—Symposium on Water Hammer—2:00 P.M.—May 6, 1952

Introduction of New Division.....Albert E. Berry
Are Standard Allowances for Water Hammer Desirable on All Types of Water Works Piping?.....S. Logan Kerr
Standard Allowances From the Viewpoint of the Consulting Engineer....Frank A. Marston
Should the Existing Information for Standard Allowances for Cast-Iron Pipe Be Revised?..Thomas F. Wolfe
Are Standard Allowances Needed for Steel Pipe in Water Works?.....Walter H. Cates
Are Standard Allowances Needed for Asbestos-Cement Pipe?.....Arthur J. Maahs
Are Standard Allowances Needed for Reinforced Concrete Pipe, Combination Lock-Joint Pipe, and Prestressed Lock-Joint Pipe?.....Hugh F. Kennison
General Discussion of Symposium
Charles H. Capen, Laurence G. Lenhardt, and Samuel B. Nelson

General Session—9:30 A.M.—May 7, 1952

Sea Water as a Source of Fresh Water.....E. D. Howe
Task Group Report—Review of Legislative Proposals and Enactments on Weather Control..E. H. Guyer, *Chairman*
Rain Increase Projects in Relation to Water Resources.....Irving P. Krick

Open Session—Steel Pipe Committee—10:00 A.M.—May 7, 1952

Committee Progress Report.....William W. Hurlbut and H. Arthur Price
Installation Procedure for Large-Diameter Pipe.....Max Socha
Some Developments in Tests of Coatings for Steel Pipe.....Graydon E. Burnett and Charles B. Masin
The New Standards for Steel Water Pipe Flanges.....H. O. Hill

Water Resources Division—2:00 P.M.—May 7, 1952

Ground Water Recharge.....Finley B. Laverty
Control of Underground Waste Disposal.....Norman F. Billings
Task Group Report—Artificial Ground Water Recharge.....Charles H. Becher, *Chairman*
Task Group Report—Industrial Water Use.....Herbert E. Hudson Jr., *Chairman*

Water Works Management Division—2:00 P.M.—May 7, 1952

A Census of Fluoridation—Natural and Applied.....O. J. Muegge
A Superintendent's Panel—Experiences With Fluoridation.....*Led by* W. Victor Weir, Walter M. Franklin, James E. Kerslake, John E. Kleinhenz, Guy Morrow, John H. Murdoch, Jr., George W. Pracy, and Jerome C. Zufelt

Water Resources Division—9:30 A.M.—May 8, 1952

Evaporation Research at Lake Hefner.....G. Earle Harbeck Jr.
Discussion.....Morrison B. Cunningham
Long-Range Water Supply Planning for Wichita.....Robert H. Hess
Committee Report—Sealing of Wells.....James C. Harding, *Chairman*
Discussion.....O. J. Muegge

Transmission and Distribution Division—9:30 A.M.—May 8, 1952

River Intakes on Variable Streams.....Vance C. Lischer and H. O. Hartung
A Study of Jute and Other Yarning Materials Used in Bell-and-Spigot Pipe.....
Charles A. Black and Wilson T. Calaway
Discussion.....Marshall P. Crabill and William E. Holy
A Survey of Service Line Installation Practices.....Walter A. Peirce

Committee Open Session—2:00 P.M.—May 8, 1952

Committee on Water Works Practice.....Louis R. Howson, *Chairman*

Committee Open Session—2:00 P.M.—May 8, 1952

Committee on Water Works Administration.....Wendell R. LaDue, *Chairman*

General Session—Federal Activities—9:30 A.M.—May 9, 1952

Civil Defense Report—Emergency Repair and Operation of Water Facilities in Disaster....
John S. Longwell
Discussion.....Morrison B. Cunningham
Relocation of Water Works Facilities in Highway Construction:
Engineering and Financial Aspects.....Harry B. Shaw
Legal Aspects.....G. H. Seig
Construction and Maintenance Controls.....Gerald E. Arnold
Discussion.....E. H. Aldrich

Papers Scheduled at 1952 Section Meetings

THERE follows a summary listing of papers scheduled for presentation at 1952 Section Meetings. The dates of the Section Meetings from 1948 to 1952 and the locations for 1952 are listed on page 1198. Section officers who were elected at meetings held during 1952 are listed on page iv in the front of this issue. The programs are listed alphabetically by Sections, without regard to the date of presentation.

Alabama-Mississippi and Florida Sections—November 16–19, 1952

Address of Welcome.....*Mayor* C. P. Mason
Response.....E. M. Stickney and Ralph F. Brennan
The Increasing Use of Water.....Charles H. Capen
Historic Controversies in Sanitary Engineering.....E. Sherman Chase
Your Government and You.....Mary D. Cain
Corrosion in Action—Part I.....*A Motion Picture*
Research in the Water Works Industry.....Harry B. Shaw
Significance of Biological Analysis for Stream Pollution Studies.....James B. Lackey
Preparing Maps of Our Distribution System.....C. C. Williams
Corrosion in Action—Part II.....*A Motion Picture*
Design and Construction Features of the Panama City Water and Sewerage Improvement Program.....A. J. Birchall
Water Supply Problems in Three Southern States.....
  Alabama.....Melvin R. Williams
  Florida.....Nevin D. Hoy
  Mississippi.....Irving E. Anderson
The Palm Beaches Sanitary District.....W. W. Gillespie
Corrosion in Action—Part III.....*A Motion Picture*
What Price Water Waste.....H. E. Beckwith
Water Use in Air Conditioning.....N. C. Ebaugh
Panel Discussion—Radio Communication for Water Systems.....
  T. G. Humphreys and William W. Aultman
Panel Discussion—Relocation of Water Works Facilities in Highway Construction.....
  Introduction.....C. F. Wertz
  Experience in Alabama and Mississippi.....*Led by* Arthur N. Beck, Jess L. Haley, James L. Mattox, W. H. H. Putnam, and W. U. Quinby
  Experience in Florida.....*Led by* C. F. Wertz, Charles H. Helwick, John G. Simmons and C. H. Stanton

Arizona Section—April 3–5, 1952

Address of Welcome.....*Mayor* O. V. Chrismon
Main Line Meters.....John L. Mapes
Venturi Meters.....C. G. Richardson
Control Instrumentation.....Emery Ferree
The Pitometer.....W. H. Wallace
Mobilized Sewer Cleaning.....*A Motion Picture*
Measurements in Flow Line.....Richard Bennett

Simple Hydraulics for Operators.....John Schaefer
Problems of a Lady Operator.....Lucy T. Whyman
Corporation Cocks.....Roy O. Hilbrant
Controlled-Materials Plan CMP–4C.....Perry C. Tummins
High-Rate Water and Sewage Treatment.....A. A. Kalinske
Review of Chlorination.....Otto Bejcek
Flow of Water in Culverts.....John G. Hendrickson
Operators Roundup.....*Led by* M. V. Ellis
Water Development—Past, Present, and Future.....Charles H. Capen
Rainfall in Arizona.....Louis R. Jurwitz
Surface Flows in Arizona.....John A. Baumgartner
Ground Water Resources.....Leonard C. Halpenny
Pipeline to the Clouds.....*A Motion Picture*
Pumping From Ground Water Resources.....Harvey Drew
Mesa Wells.....Tom Nesbitt

California Section—October 28–31, 1952

Address of Welcome.....*Mayor* Alson E. Abernethy
Response.....Joseph D. DeCosta
Forty Years Developing a Water System.....Duncan A. Blackburn
Accident Prevention.....Merle Jackson
Water System Records.....
Distribution System Records.....Frank E. Alderman
Production and Supply Records.....Marvin Owen
Importance of Records to Management.....Everett L. Clark
A Five-Foot Shelf for the Small Water Works Manager.....Ben Haggott
Legal Liability of Utilities for Service.....Harold Raines
A Scientific Approach in the Selection of Key Personnel.....Lee Stockford
Public Relations for Public Utilities.....F. A. McCanlies
Panel Discussion—Administrative Control by Responsibility Accounting.....
Led by R. M. Sedgwick,
T. M. McDaniels Jr., Peter A. Menzel, and Frank Twohy
Subdivision Pipeline Installations and Relationship to Existing Systems.....
C. J. Borgeson and R. A. Campbell
Oil Field Techniques Useful in Drilling Water Wells.....Harvey A. Mylander
Discussion.....John F. Mann Jr.
Experiments With Fresh Water Barrier to Prevent Salt Water Intrusion....Paul Baumann
Water Hammer—Its Cause, Magnitude and Prevention.....O. G. Goldman
Steel Tanks Versus Other Types of Reservoirs.....C. Kenyon Wells
The Ground Water Problem in the Central Basin.....Carl Fossett and Max Bookman
Remote Pump and Valve Controls.....Leslie Paul
Waterborne Diseases in California.....Henry J. Ongerth
The Coliform Group as an Index of Pollution.....Max Levine
Automatic Chlorinators for Small Water Systems.....Donald G. Larkin
Treatment of Water for Corrosion Control.....Richard Pomeroy
Fluoridation—Equipment, Chemical Costs, and Problems.....H. Christopher Medbery
A Rational Approach to Fluoridation.....J. E. McKee
Color and Odor Removal at the Long Beach Water Treatment Plant.....Frank T. Higgins
Panel Discussion—New Tools and Analytical Procedures for the Water Works Laboratory:
Determination of Sulfates in Water.....W. G. Hunt
Instrumentation in the Laboratory.....J. H. Wyatt
Flame Photometry.....E. W. Diskant
Coatings for Steel Water Pipe.....Walter H. Cates
Discussion of Other Means of Preventing Corrosion.....R. C. Kennedy
Expansion, Colorado River Aqueduct System.....Robert B. Diemer

Cloud Physics, Its Theory and Application.....Eugene Bollay
Cloud-seeding Operations in San Diego, Orange, and San Bernardino Counties in 1951–52...
John A. Battles
Controlled-Materials Situation.....
What Are We Doing to Improve Our Water Supply in San Diego County?..James P. Slater
Integrating Reclamation and Disposal of Waste Water.....A M Rawn
California Civil Defense Plans.....Samuel B. Nelson

Canadian Section—May 26–28, 1952

Guided Discussion—Hydrant Thread Standardization Program....*Led by* W. E. MacDonald
Experiences of a Woman Water Works Operator.....Lucy T. Whyman
A Symposium on Fluoridation of Public Water Supplies:
Fluoridation and the Dentist.....F. A. Kohli
Fluoridation and the Health Officer.....Adelard Groulx
Fluoridation and the Water Works Official.....A. E. Berry
Application of Fluoride to Water.....D. B. Williams
Guided Discussion—Supply of Water to Outside Areas.....*Led by* W. D. Hurst
The Montreal Water Works System.....F. Y. Dorrance
Construction and Operation of a Booster Pumping Station.....R. L. Dobbin
Soil Temperature in Water Works Practice.....Robert F. Legget and C. B. Crawford
Guided Discussion—The Basis of Public Liability.....*Led by* N. A. Grandfield
Guided Discussion—Miscellaneous Water Works Problems.....*Led by* A. H. R. Thomas

Canadian Section—Maritime Branch—October 21–22, 1952

Guided Discussion—General Operation of a Water Works System.....*Led by* P. C. Ahern
The Fredericton Water System.....J. Feeney
Symposium—Fluoridation.....R. S. Langstroth, H. V. Pritchard, and Harry E. Jordan
Guided Discussion—Accounting and Office Procedures.....*Led by* H. P. Gough

Chesapeake Section—October 29–31, 1952

Deep Water.....*A Motion Picture*
Address of Welcome.....*Brig. Gen.* B. L. Robinson
Fluoridation Installations.....*Led by* D. K. Harmeson
Newark, Del.....J. F. Neide
Hagerstown, Md.....R. C. Willson
Washington Suburban Sanitary Dist.....L. M. Euler
Washington, D.C.....N. E. Jackson
Fluorine as Water System Tracer.....Gilbert Levin
Ion-Exchange Treatment of Water Supplies.....Joseph Thompson
Discussion.....J. C. Tracey
Operation of Salisbury Degasifier.....P. C. Cooper
Panel Discussion—Ground Water.....*Led by* A. G. Fiedler
Resistivity in Ground Water Exploration.....A. C. Barlow
Ground Water Reservoirs:
Methods of Determining Theoretical Yields.....William C. Rasmussen
Factors Affecting Safe Yields.....Robert R. Bennett
Well Cleaning and Maintenance.....E. W. Baldwin
Expansion Program for Washington, D.C.:
Water Supply.....S. J. Trombetta
Distribution.....David Auld
Characteristics of Pump Selection.....T. M. Niles

Relation of Small Watersheds to Water Supplies.....David J. Guy
Discussion.....Edward S. Hopkins
Plant Maintenance.....A. E. McCaskey Jr.
Current Data on Silica Sols as Coagulant Aids.....Arthur B. Middleton
Water Waste Surveys.....James R. Mitchell
Discussion.....H. E. Beckwith
Rocky Gorge Dam and Reservoir Project.....Harry B. Shaw

Florida Section—November 16–19, 1952

See Alabama-Mississippi Section.

Illinois Section—March 26–28, 1952

Waters of the Commonwealth.....*A Motion Picture*
Filter Techniques in Water Examinations.....Harold S. Clark
Results of Chicago Studies on Methods for Testing Water Supplies for Radioactivity.....
H. H. Gerstein
Sanitary Engineering Aspects of Fluoridation of Public Water Supplies.....W. J. Downer
Evanston Dental Caries Study.....Horace R. Frye
Open Discussion of Fluoridation.....*Led by* George E. Symons
Manufacture of Cast-Iron Pipe.....*A Motion Picture*
Military Water Supply in the Field.....John Collins
Panel Discussion—Corrosion Problems in Water Works Systems.....
T. E. Larson, Dewey W. Johnson, John R. Baylis, and E. T. Erickson
Interesting Facts on Water Works Operation and Maintenance.....Wendell R. LaDue
Water Supply Problems of a Fast Growing Community.....Robert Enzweiler
Panel Discussion—My Most Difficult Operating Problem of Last Year.....
F. H. King, John H. Blesse, John Drause, Fred F. Penning,
Elmo Conrady, and Charles L. Baylor
Pipeline to the Clouds.....*A Motion Picture*
Use of Industrial Water in Illinois.....W. J. Roberts
Use of Industrial Water by the Corn Products Industry.....W. J. Lauterbach
Use of Industrial Water in the Meat-packing Industry.....M. D. Sanders
Water Problems in Steam Power Plants.....C. J. McLean
Improving the Water Supply for O'Hare Field.....R. A. Thompson

Indiana Section—February 13–15, 1952

Suburban Main Extension Policy.....W. Victor Weir
Discussion.....A. O. Norris
Automatic Sprinkler Systems and the Public Water Supply.....Robert F. Hamm
Procurement of Water Works Materials Under Government Control.....Gerald E. Arnold
Panel Discussion—Posttreatment of City Water for Industrial Processes and Other Industrial Uses:
Control of Boiler Feedwater and Cooling Waters.....S. M. Paradiso
Processing Water for Bottled Beverages.....William M. Mingee
Prevention of Scale Formation in Heat Exchangers.....Robert R. Bennett
Pipeline to the Clouds.....*A Motion Picture*
Prospecting for New Ground Water Supplies.....Carl A. Bays and Robert N. M. Urash
Minimizing Hazards in Water Works Industry.....Jerome Powers
Lessons From the Kansas City Flood.....Melvin P. Hatcher
Payment for Utility Changes Required by Highway Construction.....H. A. Kerby

Iowa Section—October 23–25, 1952

Welcome.....*Mayor* H. E. Bruce
Panel Discussion—Fluoridation.....*Led by* W. J. Lang
Public Relations.....Leo Louis
AWWA Policy.....Dale Maffitt
State Department of Health.....Paul Houser
Installations in Service.....T. G. Sliter
Opposition.....R. O. Ellis
Elevated Tanks:
Cathodic Protection.....Frank B. McDonald
Painting and Maintenance.....Earl Bagenstos
Needs and Design of Elevated Tanks.....Frank L. Maine
State Utility Commission.....C. M. Updegraff
State Pension System.....W. W. Wage
Membrane Filters.....R. L. Morris
Revenues and Rates.....C. K. Mathews
Highlights of Visit to India.....F. M. Dawson
Questions and Answers—Stump the Experts.....*Led by* P. F. Morgan
Panel Discussion—Financing Water Main Extensions.....*Led by* H. V. Pedersen, Dale Maffitt, John Pray, and Mark Driftmier
Manufacturing of Cast-Iron Pipe.....*A Motion Picture*
Manufacturing Water Meters.....*A Motion Picture*

Kansas Section—May 3, 1952

Welcome.....*Mayor* Clark E. Tucker
Response.....Robert H. Hess
Fluoridation of Water Supplies.....Charles R. Cox
Certification and Licensing of Water Works Operators.....Raymond J. Faust

Kentucky-Tennessee Section—September 15–17, 1952

Address of Welcome.....*Mayor* George R. Dempster
Response.....John F. Connerton
Address by President of American Water Works Association.....Charles H. Capen
The Forest and the Trees.....W. H. Wisely
Need for Engineers.....N. W. Dougherty
Preparing a City's Utilities for New Industry.....*Mayor* John R. Long Jr.
Administration of a City's Utilities.....M. U. Snoderly
Water and Sewer Service to Suburban Areas.....Lorin B. Allen
Short Coupled Turbine Pumps for Station Installations.....A. O. Fabrin
Fire Protection Requirements.....William J. Dahlgren
The Manufacture of Cast-Iron Pressure Pipe.....*A Motion Picture*
Ground Water Resources of East Tennessee.....R. M. Richardson
Current Water Works Headaches.....E. D. Hawkins
Legal Problems Confronting Water Works Management.....John H. Murdoch Jr.
NPA Controls.....V. A. Appleyard
Panel Discussion—Fluoridation:
How Pressure Is Brought on Water Works Management.....C. M. McCord
Methods and Safeguards in Applying Fluorides.....J. Wiley Finney Jr.
Customers' Reaction to the Application of Fluorine.....B. E. Payne
Taste and Odor Control Methods.....Henry F. Laughlin
Flood Control and Water Resources Program in Kentucky.....Orville Chinn
Short and Correspondence Courses for Operators.....H. K. Gidley

Michigan Section—September 24–26, 1952

Address of Welcome.....*Commissioner* Orville DeBolt
Response.....Louis E. Ayres
News of the Field.....John E. Vogt
Report—1953 National AWWA Conference.....Edward D. Barrett and Raymond J. Faust
Control of Water Treatment in Piping System of Buildings.....Andrew T. Dempster
Panel Discussion—Keeping Your Customers Happy.....*Led by* Raymond J. Faust, Ivan Fosheim, Robert E. Hansen, and Robert D. Strumper
Michigan Section Education Program.....Douglas Feben
The Manufacture of Cast-Iron Pressure Pipe.....*A Motion Picture*
"Help! Highwaymen".....Earl E. Norman
Tailoring Water for Commercial Customers:
  Paper Mills.....Charles M. Waddle
  Food Processing.....H. L. Senseman
  Canning Industry.....Alfred D. Truman
  Manufacturing.....Francis Kallin
  Bottled-Beverage Industry.....W. M. Mingee
Battle Creek Water Supply:
  Master Plan of Improvements.....Tom Henry
  Improvements Completed.....Robert R. McIntosh
Preventive Maintenance.....Kenneth E. Garvey
Perpetual Inventories.....Maurice C. Stout
How Do You Do It?
  Meters.....Howard Hartung
  Hydrants.....George Schmid
  Valves.....Harold B. Huntley
  Disinfection of Mains.....Chester C. Conn
  Flushing Dead Ends.....Paul Stegeman

Minnesota Section—September 9–12, 1952

Address of Welcome.....*Mayor* Henry B. Saure
Response.....N. S. Bubbis
Ground Water Geology of South Dakota.....Bruno Petsch
Pumps and Pump Efficiencies.....Arnold M. Steffes
Relation of Water Works Characteristics to Insurance Rates.....W. C. Freitag
  Discussion.....N. S. Bubbis
Steel Storage Tank Maintenance.....E. L. Lium
Realm of the Wild.....*A Motion Picture*
New Water Treatment Plant at Sioux Falls.....John N. Browning and R. E. Bragstad
Revaluation of Rate Structures.....Samuel Greeley
Whistling Wings.....*A Motion Picture*
Panel Discussion—Fluoridation Practices.....*Led by* O. J. Muegge, C. C. Crumeley, A. E. Williamson, and O. E. Brownell

Missouri Section—September 21–23, 1952

Sanitary Problems in Karachi, Pakistan.....Vance C. Lischer
Chlorination Principles and Practices.....Harry A. Faber
Innovations in Water Purification Plant Design.....E. H. Aldrich
  Discussion.....H. O. Hartung
The American Water Works Association.....Raymond J. Faust
A Safety Program for the Water Utility.....J. B. Ramsey
Operational Aids and Shortcuts for the Plant Operator.....Robert Hayob
Metal Spraying, a Maintenance Aid for the Plant Operator.....Walter Meyer
Cathodic Protection in Hot-Water Tanks.....W. A. Derringer

Recent Developments in Municipal Financing.....Burton L. Oliver
Discussion.....Eugene J. Meyer and Albert Ayre
Panel Discussion—Fluoridation.....*Led by* W. Victor Weir
Fluoridation From the Viewpoint of:
A Water Commissioner.....T. J. Skinker
The Food and Beverage Industry.....George Bratton
A Public Health Official.....Herbert R. Domke
A Consulting Engineer.....Ellsworth L. Filby
Booster Pump Controls.....Dan Moroney
McIlroy Analyzer—Its Use and Limitations.....Glen Hands
Operation Aids and Shortcuts for Distribution System Maintenance.....Raymond Piner
Leak Detection.....D. L. Blaik

Montana Section—April 11–12, 1952

Address of Welcome.....*Mayor* T. T. Rowe
Response.....Harry McCann
Pipeline to the Clouds.....*A Motion Picture*
Critical Materials—Current Situation.....Gerald E. Arnold
Electronic Controls for Chlorination.....John Hazen
Round Table Discussion.....*Led by* Arthur Johnson
Civilian Defense.....H. A. McKinney
The Current Discussions of a National Water Resources Policy.....Harry E. Jordan
Panel Discussion—Stream Pollution.....Glen Hopkins, Robert Harris, C. W. Brinck, H. B. Foote, F. F. Palmer, L. O. Williams, and Richard Setterstrom

Nebraska Section—April 17–18, 1952

Welcome.....*Mayor* Victor E. Anderson
Response.....Vern Livingston
Increasing Diesel Engine Ratings.....C. E. Beck
Procurement of Materials Today.....F. W. Moeller and Herluf Nelson
Comparative Diesel Engine Operating Costs.....L. E. Clark
Retirement of Utility Employees Under Social Security.....J. W. Kruse
Manufacture of Cast-Iron Pipe.....*A Motion Picture*
Use of Aluminum Conductors in Distribution Systems.....Gordon Parhm
Minimum Standards for Water Distribution Systems.....E. C. Wagner
Panel Discussion—Maintenance and Repair of Elevated Tanks.....*Led by* Bert Gurney, John W. Cramer, Carl Fisher, and Herbert Miller
Panel Discussion—Use of Tools and Equipment in Maintenance and Repair of Water Mains *Led by* Charles Elliott, Vern Livingston, E. D. Bonine, and Herbert Marshall
Operation of Municipal Swimming Pools by the Utilities.....Harry L. Morris
Water Meter Setting and Service Practices.....Harry V. Seevers
How to Make Your Water Department Solvent.....E. D. Bonine

New Jersey Section—October 23–25, 1952

Slides.....Steven Senko
Thirty Minutes With Screwball Inventions.....Charles G. Richardson
Peddler's Showcase Session.....*Led by* Ivan M. Glace
Water Works Equipment and Cathodic Protection.....R. J. Walton
Two-Way Radio Communication for Water Works.....Severin Barstad
Application of Mechanical Joints to Cut-in Valves, Tapping and Repair Sleeves Harry Gaffin
Standardized Mechanical-Joint Pipe.....A. F. Pleibel
New Horizons.....P. S. Wilson

Safe as You Think.....*A Motion Picture*
A Practical Water Works Safety Program.....G. E. Linn
Discussion.....R. A. Edwards
Temperature Deficiency and Frost Penetration Studies.....
J. G. Carns Jr. and Martin E. Flentje
Research in the Water Works Field.....George D. Norcom
Discussion.....P. E. Pallo
The New Water Treatment Works for Trenton, N.J.—Design and Financial Aspects
Lewis W. Klockner
Burlington's Improvement Program.....Alonzo Shinn
A Financial Man's View of the Water Works Business.....George I. McKelvey
Meeting Today's Phenomenal Demands for Public Utility Services.....J. L. Fitzgerald
Panel Discussion—Disaster Control of New Jersey's Water Supplies..*Led by* E. Arthur Bell, Thomas S. Dignan, George R. Shanklin, Robert S. Shaw, and Herbert R. Bogardus

New York Section—April 17–18, 1952

Priorities and Materials.....Gerald E. Arnold
New Developments in Civil Defense and Mutual Aid.....Earl Devendorf
Water Authorities Pro and Con.....Alexander Russell
The Training of Water Works Operators.....William T. Ingram
Round Table Conference.....*Led by* S. P. Carman

New York Section—September 4–5, 1952

Mechanical-Joint Pipe.....Thomas F. Wolfe
Guides for Selection of Dry-Feed Machines.....Paul A. Coffman Jr. and M. A. Safford
Civil Defense and Water Supply.....Earl Devendorf
Water Main Cleaning.....J. A. Frank
Discussion.....Larry Griswold
Round Table Conference.....*Led by* S. P. Carman

North Carolina Section—November 10–12, 1952

Address of Welcome.....*Mayor* A. V. Edwards
Hendersonville Water Works.....W. F. Stokes
Fluoridation Practices—Water Works Management Viewpoint.....W. M. Franklin
Panel Discussion—Instrumentation.....*Led by* John W. Dandridge
Modern Instruments as Aids to Water Plant Operation.....H. D. Fesperman
Use of Meter Master in Winston-Salem.....Stanford E. Harris
Homemade Alarms and Controls.....Wilbur E. Long Jr.
Maintenance and Repairs to Cathodic Protection Systems.....F. J. LeFebvre
Discussion.....Herbert F. Finck
Forecasting North Carolina's Industrial and Community Growth.....Brandon P. Hodges
Planning Water and Sewage Facilities for Future Growth..H. E. Beckwith and P. D. Davis
A Proposal for Solving Water and Sewage Needs for Suburban Areas.....
Jackson T. Ramseur and William N. Long
Classification of Streams.....L. F. Warrick

Ohio Section—September 18–19, 1952

Disposal of Treatment Plant Wastes.....H. H. Mace
High-Capacity Zeolite for Water Softening.....J. W. Strub
Maintenance of Wells.....E. W. Bennison
Treatment Plant Operation and Maintenance.....J. A. Marsh
Made to Measure.....*A Motion Picture*

Manufacture of Cast-Iron Pipe.....*A Motion Picture*
Akron Experience in Sizing and Maintaining Fire Protection, Industrial, and Commercial Services and Meters.....L. W. Bausher
Financing Utility Changes Occasioned by the Ohio Highway Construction Program.....R. H. Fuller

Pacific Northwest Section—April 24–26, 1952

Pipeline to the Clouds.....*A Motion Picture*
A Program for an Informed Public.....M. C. Glaze
More Than Water.....Clem Stearns
Material Procurement Controls.....Gerald E. Arnold
Panel Discussion—Should We Fluoridate?.....*Led by* H. Loren Thompson
Fluoridation and Public Relations.....E. J. Allen
A Dentist Looks at Fluoridation.....E. O. Hoffman
Five Years' Experience at Lewiston.....Winston H. Berkeley
Fluoridation for the Larger City.....Thomas Meador
Fluoridation for the Smaller City.....T. F. Edwards
Special Technical Problems.....R. Trumbull Smith
Canadian Practice.....Ralph Davis
Corrosion.....George W. Gleeson
Guided Discussion..Larvae Growth in Reservoirs.....*Led by* R. A. Duff
What They Are and What They Like.....W. F. Barr
Experiences at Walla Walla.....P. H. Meyer
Experiences at Corvallis.....H. D. Taylor
Logging of Watersheds:
General Procedure.....Allen Thompson
Effect on Runoff.....Merrill E. Deters
Effect on Quality.....W. E. Bullard
Proceeds From Logging.....M. O. Gardner
Sanitary Controls.....M. H. McGuire
Cleaning up After Logging.....E. L. McCleary and C. C. Casad
Experiences With Dual Water Systems
Irrigation Leads on Water Systems.....R. C. Smolinski
Dangers to Health.....W. W. Saxton
Operation Problems.....H. L. Derrick and H. D. Grims
Advantages and Disadvantages.....Walter Hereth
The Question Box Session.....*Led by* Roger James
Panel Discussion—Financing Water Works Improvements:
The Bond Buyers' Viewpoint.....F. M. Ackley
Legal Requirements.....Harold Shefelman
Administrative Viewpoint.....Don C. Sampson
Special Requirements and Types of Bonds:
Washington.....F. M. Ackley
Oregon.....Raymond Botch
Idaho.....Joe Latimore
Panel Discussion—Civil Defense:
Report of the Equipment Standardization Committee for Civil Defense.....Elmo James
The Water Works Superintendent in a Civil Defense Emergency.....Harold E. Milliken
Coordination of the Water Utility With Other Agencies.....V. P. McNamara
Civil Defense in British Columbia.....C. R. Stein
Guided Discussion—Practical Aids to Taste and Odor Control.....*Led by* John Berning
Algae and Chlorine Tastes.....John Wilson
Control of Tastes and Odors From Algae With Chlorination.....C. R. Harlock
Use of Activated Carbon and Copper Sulfate.....Winston H. Berkeley
Panel Discussion—Filter Operation Problems.....*Led by* Winston H. Berkeley, Edward A. Armstrong, A. H. Labsap, R. D. Berry, and C. F. Whestler
Progress in Water Works Construction in Spokane.....James B. Fiskin

Pennsylvania Section—June 18–20, 1952

Made to Measure.....*A Motion Picture*
Symposium on Water Quality, Tastes and Odors—Phenol-like Substances.....
Led by R. B. Adams,
F. W. Bouson, D. E. Chase, R. W. Kremer,
Rudy Cunjak, Grant A. Pettit, and J. E. Kinney
Water Works Administration—Small Plants.....Wendell R. LaDue
Water Works Operators Certification.....L. D. Matter
Instrumentation in Water Works.....James States
Symposium on Water Authorities.....*Led by* William H. Markus
Legal Aspects.....William H. Markus
Historical Background and Present Status in Pennsylvania.....C. S. Braucher
Changes in Bond Indentures.....Charles Fisher
Management Problems.....I. S. Sahli
Operation Problems.....J. C. DeGroot
The Water Works Industry Needs a Safety Program.....R. J. Faust
Water Treatment at Erie.....J. D. Johnson
Improvements to Westmoreland County Municipal Authority System:
Distribution System Extensions.....J. L. Matthews
Filter Plant Design.....E. H. Aldrich
Symposium on Fluoridation of Public Water Supplies.....*Led by* Gerald J. Cox
Why, When, and How.....Gerald J. Cox
The Situation in Pennsylvania.....Linwood G. Grace
Legal Aspects.....John H. Murdoch Jr.

Rocky Mountain Section—September 15–17, 1952

Welcome Address.....*Governor* F. A. Barrett
Response.....Ray Sherard
Planning With AWWA in 1952.....M. B. Cunningham
State Department Policies in Relation to Water Supplies.....F. D. Yoder
Discussion.....William N. Gahr and Charles G. Caldwell
Problems of a City Manager Relating to the Water System.....Ray Case
Factors That Determine the Basic Fire Insurance Rates.....D. G. Mees
Construction and Maintenance Controls.....J. C. Crenshaw
Water Conservation Through Metering and Effects on Revenue.....E. L. Mosley
State Versus Federal Control on Water Diversion.....Glenn G. Saunders
Deep Water.....*A Motion Picture*
Contamination of Water Supplies by Radioactive Materials.....William N. Gahr
Theory of Coagulation on an Elementary Basis.....R. Ernest Leffel
Filtration.....O. J. Ripple
Fluoridation of Municipal Water Supplies.....R. P. Moffitt

Southeastern Section—March 24–26, 1952

Address of Welcome.....*Mayor* Hugh L. Hamilton
Response.....Sherman Russell
Water Works Laboratories—Layout and Operations.....W. C. Bowen
Pipeline to the Clouds.....*A Motion Picture*
Panel Discussion—Fluoridation.....*Led by* W. E. Whitaker
Fluoridation of Domestic Water Supplies.....Franz J. Maier
Handling and Feeding Fluoride Compounds.....L. E. Harper
Fluoridation From Public Standpoint.....L. H. Enslow
Fluoridation From Operator's Standpoint.....W. H. Weaver and J. D. Lesslie

Procurement of Critical Materials.....Gerald E. Arnold
Discussion.....H. F. Wiedeman
Employee-Management Relations of Water Utilities.....Paul Weir and J. C. Cousins
Collection of Sewer Service Charges by Water Departments.....
John F. Pearson, V. D. Parrott Jr., and H. M. Crane
Water Works and Local Civil Defenses.....Gilbert R. Frith and R. L. Crutchfield
Distribution System Records.....P. B. Therrell and George R. Lowe

Southwest Section—October 12–15, 1952

Welcome Address.....*Mayor* C. M. Warren
Response.....Henry Wilkens Jr.
Evaluating Water Supply Requirements for a Region.....John R. Stockton
Panel Discussion—Distribution System Problems.....*Led by* M. B. Cunningham, Russell W. Hall, K. F. Hoefle, and Marvin C. Nichols
The Use of Flural at the Ottawa, Kan., Water Plant.....E. L. Haff
Tulsa Water Works System Development.....W. F. McMurry
Bacteriological Membrane Filters for Water Works.....Harold L. Jeter
Pumps and Motor Maintenance.....Beverly E. Ryan
The Effect of Irrigation and Return Flow on Water Supplies.....Norman C. Flaigg
Research Discussion Period.....O. M. Smith
Chemistry of Natural Waters.....W. W. Hastings
Alternating-Current Network Calculator in Distribution System Problems..George W. Reid
Trenton Cleans Its Mains.....*A Motion Picture*
Pipeline to the Clouds.....*A Motion Picture*
Water Film.....*A Motion Picture*
Made to Measure.....*A Motion Picture*
The 1951 Flood at Miami, Okla.....Harvey G. Freehauf
Civil Defense for Water Works.....Gaines F. West
Your Job and Public Relations.....M. L. Powers
Panel Discussion—Cost of Utilities Relocation Due to Urban Highway Construction.....
Led by M. B. Cunningham

Virginia Section—November 5–7, 1952

Selection, Positioning, and Servicing Chemical Feeders.....R. J. Leveque
Discussion.....*Led by* G. R. Talcott
Water Works Picture:
Alexandria, Va.....E. H. Aldrich
Norfolk, Va.....W. G. Beazley
Newport News, Va.....M. G. Welsh
Panel Discussion—Some Problems of a Small Water Works.....*Led by* Richard Messer, W. R. Moore, Brent Remsburg, G. H. Dougherty, I. T. Jessee, C. H. Long, and R. H. Coltrane
Made to Measure.....*A Motion Picture*
New Alloys and Materials of Construction for Special Chemicals—What Is Available, Service, and Ease of Installation.....L. R. Honnaker
Safety Is Good Business.....Raymond J. Faust
Panel Discussion—Billing and Collection Problems.....*Led by* R. D. Wright, H. B. Rice, J. E. Metzger, and Seth Burnley
Progress on Raw Water Purification.....A. H. Paessler
Factors Relating to Coagulation and Its Effect on Fluoridation.....F. E. Stuart
Panel Discussion—Distribution System—Maintenance, Repairs, and Practices.....
Led by Whitworth Cotten, J. B. Ferguson, R. L. Maury, and T. W. Edwards

West Virginia Section—October 2–3, 1952

Pipeline to the Clouds.....*A Motion Picture*
Address of Welcome.....C. C. Coffield
Water Control Through Statistical Control.....E. C. Mayo
Fluoridation of Public Water Supplies.....Frank E. Law
Performance of Plastic Pipe in the Pax, W.Va., Water System.....Dennis Leary
Memories of Early Water Works Meetings in West Virginia.....W. S. Staub
Made to Measure.....*A Motion Picture*
The Membrane Filter in Water Bacteriology.....Guido Iannarelli
Fairmont's New Double-Deck Sedimentation Basin.....Edward Shroyer
Corrosion Problems in West Virginia Water Works.....William Kirchman
Combating Extreme Pollution at the Clarksburg Water Plant Following West Virginia's Largest Fire.....Henry Gay
Installation and Performance of Horizontal Collector Wells in Ohio River Gravels.....Harry K. Gidley
Jointing Materials for Water Pipe.....Donald F. Deakin
Planning With AWWA in 1952.....M. B. Cunningham
Panel Discussion—Stream Quality as It Affects Water Use in West Virginia.....*Led by* George F. Jenkins

Wisconsin Section—September 16–18, 1952

Welcome.....*Mayor* George Forster
Water Levels of the Great Lakes.....Col. Kumpe
Surface Water in Wisconsin.....E. F. Bean
Round Table Discussion.....William U. Gallaher, George Steinmetz, Harry J. Draves, R. W. Nicholson, and C. F. Micolazzo
Waters of the Commonwealth.....*A Motion Picture*
The Construction and Development of Deep Wells in Wisconsin.....William A. McEllhiney
Drilling Wells in the Glacial Drift at Rockford.....H. S. Merz
Round Table Discussion.....William A. McEllhiney, H. S. Merz, Henry A. Ehlers, Joseph Lustig, and Eugene R. Kelly
The Manufacture of Cast-Iron Pressure Pipe.....*A Motion Picture*
Automatic Controls.....J. S. Williams
Red Water and Its Prevention.....Philip Davy
Round Table Discussion....J. S. Williams, Philip Davy, Harvey E. Wirth, and E. Tornow
Artificial Rainmaking.....V. E. Soumi
Works Works Improvement Planning.....John C. Doerfer
Water Main Extension Records.....Orville P. Deuel
Round Table Discussion.....John C. Doerfer, Orville P. Deuel, Arthur P. Kuranz, and P. A. Reynolds

Section Membership at Time of, and Total Attendance at, Section Meetings—1948–1952

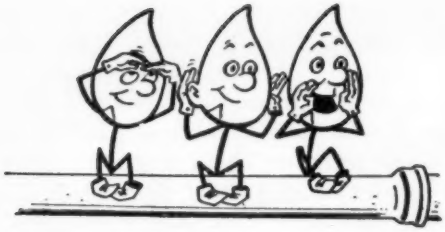
SECTION	1948		1949		1950		1951		1952	
	Membership	Attendance	Membership	Attendance	Membership	Attendance	Membership	Attendance	Membership	Attendance
Alabama-Mississippi	137	116	164	140	167	141	163	181	169	400††
Arizona‖	41	159	69	181	83	93	72	154	71	173
California‖	770	1,133	826	831	947	1,267	1,028	1,252	1,044	1,434
Canadian	459	732	485	574	515	728	531	516	582	756
Chesapeake	*	*	209	196	245	149	247	119	241	250
Cuban	36	75	57	71	61	216††	65	52	73	†
Florida	190	103	216	174	240	216††	300	282	306	400††
Four States	343	191**	#	#	#	#	#	#	#	#
Illinois	402	321	450	‡	459	284	470	348	475	418
Indiana	201	242	207	266	256	264	289	299	333	392
Iowa	95	157	102	138	109	242	115	195	119	182
Kansas	110	118	113	168	139	179	139	186	187	†
Kentucky-Tennessee	138	206	196	153	199	222	186	202	186	252
Michigan	232	248	254	211	284	214	294	225	319	242
Minnesota	172	322	182	169	208	177	216	167	230	179
Missouri	154	197	157	199	169	125	181	202	190	225
Montana	63	108	61	94	58	140	62	120	59	168
Nebraska	41	†	54	18	55	23	64	158	75	152
New England	172	‡	187	‡	192	‡	205	‡	211	‡
New Jersey‖	320	208	339	218	350	218	379	276	411	311
New York‖	644	200	643	250	682	†	715	340	743	375
North Carolina	174	238	171	226	176	222	178	242	182	261
Ohio	364	258	380	308	382	321	392	320	400	297
Pacific Northwest	264	260	277	267	295	330	299	257	315	267
Pennsylvania	*	*	345	147	390	182	419	214	433	215
Rocky Mountain	135	74	147	86	145	126	141	128	157	122
Southeastern	149	154	152	161	170	152	181	§	190	220
Southwest	558	545	659	618	678	795	702	708	779	582
Virginia	154	224	167	228	171	215	177	84	183	237
West Virginia	88	172	87	123	92	154	94	156	98	130
Western Pennsylvania	159	191**	#	#	#	#	#	#	#	#
Wisconsin	146	239	143	301	150	290	164	305	176	314

* Section not then organized.
† No record of attendance.
‡ No regular meeting scheduled. Membership given as of dates of conferences.
§ Regular meeting cancelled. Business meeting held at annual conference.
‖ Only one of section's meetings recorded here.
\# Section discontinued.
** Joint meeting, to form Chesapeake and Pennsylvania Sections.
†† Joint meeting.

Section Meetings—1948–1952

Section	*1948*	*1949*	*1950*	*1951*	*1952*	*Meeting Place—1952*
Alabama-Mississippi	Oct. 13–15	Oct. 19–21	Oct. 11–13	Sept. 24–26	Nov. 16–19	Pensacola, Fla.
Arizona	Apr. 2–4	Apr. 1–3	Mar. 31–Apr. 2	Mar. 28–31	Apr. 3–5	Mesa, Ariz.
	Oct. 15–17	Nov. 11–13	Nov. 30–Dec. 2	——	——	——
California	——	Apr. 29*	Apr. 21*	Apr. 6*	Apr. 17–19*	Yosemite National Park, Calif.
	Oct. 27–29	Oct. 25–28	Oct. 24–27	Oct. 23–26	Oct. 28–31	Pasadena, Calif.
Canadian	Apr. 12–14	Apr. 25–27	Apr. 3–5	May 21–23	May 26–28	Montreal, Que.
	——	——	——	——	Oct. 21–22†	Fredericton, N.B.
Chesapeake	——	Nov. 2–4	Nov. 1–3	Oct. 31–Nov. 2	Oct. 29–31	Washington, D.C.
Cuban	Dec. 2–4	Dec. 1–3	Nov. 13–15	Nov. 29–Dec. 1	Dec. 4–6	Havana, Cuba
Florida	Nov. 18–20	Nov. 14–16	Nov. 13–15	Oct. 28–31	Nov. 16–19	Pensacola, Fla.
Four States	Oct. 20–22	——	——	——	——	——
Illinois	Apr. 15–16	——	Apr. 12–14	Mar. 28–30	Mar. 26–28	Chicago, Ill.
Indiana	Apr. 21–23	Apr. 20–22	Apr. 26–28	Feb. 7–9	Feb. 13–15	Indianapolis, Ind.
Iowa	Oct. 5–6	Oct. 6–7	Oct. 26–27	Oct. 25–27	Oct. 23–25	Mason City, Iowa
Kansas	Mar. 11–12	Apr. 21–22	Apr. 19–21	Apr. 11–13	May 3	Kansas City, Kan.
Kentucky-Tennessee	Aug. 23–25	Oct. 31–Nov. 2	Oct. 23–25	Sept. 17–19	Sept. 15–17	Knoxville, Tenn.
Michigan	Sept. 22–24	Sept. 28–30	Oct. 25–27	Sept. 19–21	Sept. 24–26	Battle Creek, Mich.
Minnesota	Sept. 1–2	Sept. 8–9	Sept. 6–8	Sept. 12–14	Sept. 9–12	Sioux Falls, S.D.
Missouri	Oct. 24–26	Sept. 25–27	Oct. 1–3	Sept. 30–Oct. 2	Sept. 21–23	Jefferson City, Mo.
Montana	Apr. 9–10	Apr. 8–9	Apr. 21–22	Apr. 20–21	Apr. 11–12	Billings, Mont.
Nebraska	Apr. 22–23	Apr. 21–22	Apr. 13–14	Apr. 19–20	Apr. 17–18	Lincoln, Neb.
New England	——	——	——	——	——	——
New Jersey	——	Feb. 17	Feb. 15	Feb. 14	Feb. 13	Newark, N.J.
	——	June 23	——	June 29	June 25	Martinsville, N.J.
	Nov. 4–7	Nov. 17–19	Oct. 26–28	Oct. 25–27	Oct. 23–25	Atlantic City, N.J.
New York	——	Jan. 21	Jan. 17	Jan. 16	——	——
	Apr. 1–2	Apr. 28–29	Mar. 30–31	Apr. 5–6	Apr. 17–18	Syracuse, N.Y.
	Sept. 14–17	Sept. 6–7	Sept. 7–8	Sept. 13–14	Sept. 4–5	Saranac Inn, N.Y.
North Carolina	Nov. 8–10	Nov. 7–9	Nov. 13–15	Nov. 12–14	Nov. 10–12	Hendersonville, N.C.
Ohio	Oct. 7–8	Nov. 3–4	Sept. 28–29	Sept. 27–28	Sept. 18–19	Cincinnati, Ohio
Pacific Northwest	May 13–15	May 12–14	May 11–13	May 17–19	Apr. 24–26	Spokane, Wash.
Pennsylvania	——	Sept. 14–16	Oct. 18–20	Sept. 19–21	June 18–19	Erie, Pa.
Rocky Mountain	Sept. 15–17	Sept. 21–23	Sept. 27–29	Sept. 24–25	Sept. 15–17	Cheyenne, Wyo.
Southeastern	Dec. 6–8	Dec. 5–7	Oct. 23–25	——	Mar. 24–26	Augusta, Ga.
Southwest	Oct. 11–13	Oct. 10–12	Oct. 16–18	Oct. 14–17	Oct. 12–15	Tulsa, Okla.
Virginia	Oct. 25–26	Oct. 24–25	Nov. 6–7	Nov. 7–9	Nov. 5–7	Old Point Comfort, Va.
West Virginia	Sept. 30–Oct. 1	Sept. 22–23	Sept. 13–14	Oct. 4–5	Oct. 2–3	Parkersburg, W.Va.
Western Pennsylvania	Oct. 20–22	——	——	——	——	——
Wisconsin	Oct. 28–29	Oct. 11–13	Sept. 19–21	Sept. 25–27	Sept. 16–18	Madison, Wis.

* Regional meetings. † Maritime Branch.



Percolation and Runoff

Anonymosity ill concealed has been the lot of P&R contributors for four Decembers past, and this year—unlike this year in at least one other respect—promises to be not only no different, but more so. More so happily, however, for the more are more members of Editors Anonymous in this, the year of its wooden jubilee—more members who contributed more material more often than ever before.

Keeping faith with these innominates of ours, we have continued to shield their identity from any and all of the confused, the curious, and the malintent among the followers of P&R, but to the Bureau of Internal Revenue, of course, we have, as usual, had to yield on both principle and principal. Thus, considering a payment deserved a payment earned, we have made a full editor-by-editor accounting of earnings withheld and taxes not, during 1952, more or less secure in the knowledge of a corresponding permissible deduction for nonreceipt.

Our characteristically obscure point in all this incomedy is merely this: Whereas we have reported the earnings that our contributors deserve, and whereas the highest incomes in the country are regularly made public, therefore be it obvious that the names of all members of Editors Anonymous will appear at the top of the list. And rather than give the Bureau of Internal Revenue the satisfaction of putting the finger on them, we bracket below all 31 on this year's membership rolls without actually divulging the amounts that they weren't paid:

Top bracket, top hole, and just plain tops were this year's *Incurables*—those who scissored and sent in endless streams of material for mutilation and publication in P&R. And for the first time, Ellsworth Filby, Joe Wafer, and Syd Wilson, who jointly necessitated the designation and have lived up to it throughout, had company in their incorrigibility. Newly soundly smitten were Charlie Capen, Bob Hansen, Vic Weir, and Don Williams, all entitled now to sign with "Inc."

No less seized but a little less often were this year's *Deetees*—Jack Diven, Wendell LaDue, Sig Sigworth, and Doc Symons. Repeaters all,

(Continued on page 2)

(*Continued from page 1*)

and now confirmed habitualists, they ought to be almost imminently "Incurable."

Often, but not yet regular, in their contributionitis are the *Shakes,* represented this year by Ray Jones, Hugh Kellner, Rolf Eliassen, and N. M. deJarnette. And since all of last year's "Shakes" have progressed to the more acute stages of EAism, we'll wish these, too, busier clip joints.

Finally and fundamentally come the *Jitters*—fifteen strong and only a wee bit afflicted. Touched only once or twice, and often unconsciously, these are the backbone of the EA staff: R. N. Aston, W. N. Beadle, A. P. Black, R. K. Blanchard, J. R. Brown, J. G. Copley, M. E. Flentje, B. A. Furman, J. S. Jansson, J. E. Kleinhenz, G. J. Natt, W. A. Peirce, H. D. Schmidt, Jack Service, Samuel Shenker, and T. V. Wood.

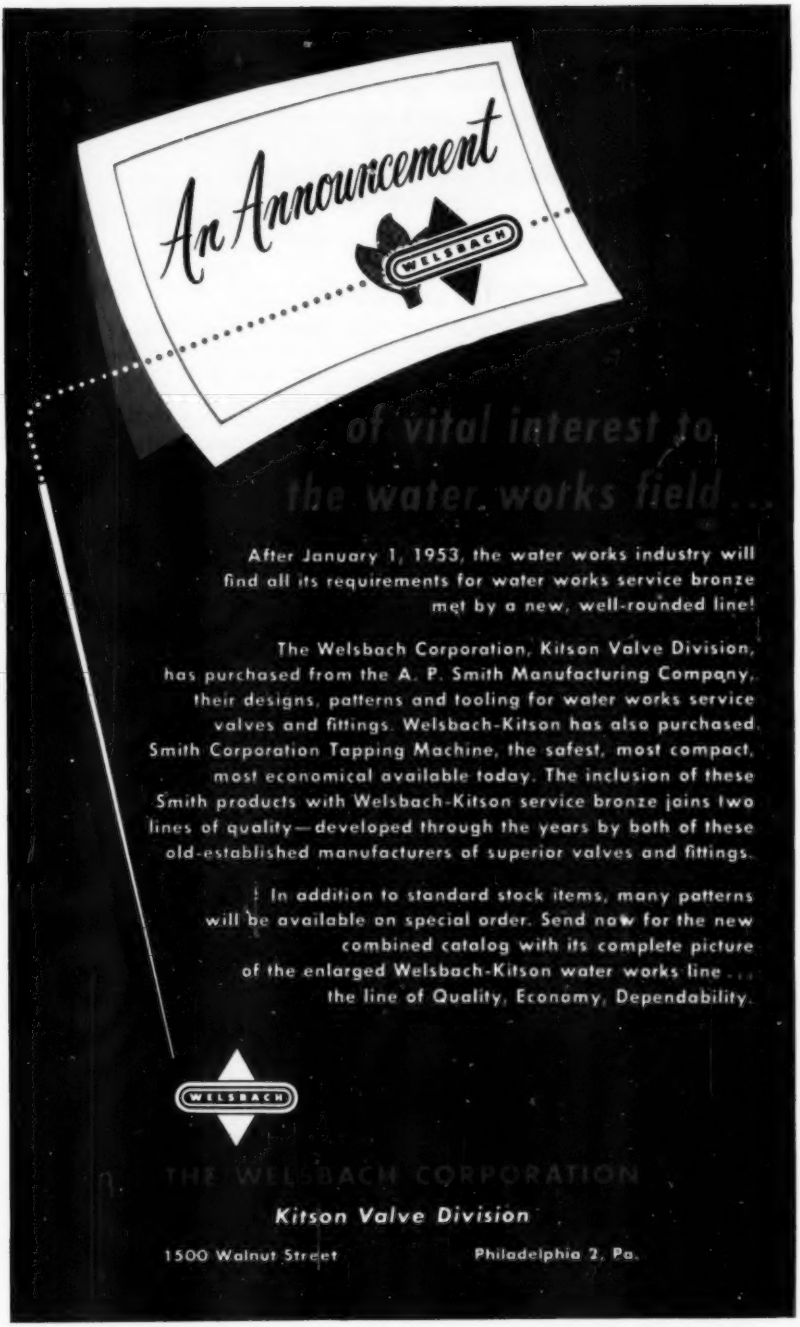
Altogether 31, and with everyone a Santa Claus to us, we're just loaded with Christmas spirit—so loaded in fact that we're willing to wish even noncontributors a Merry Christmas and a Happy New Year resolution.

Settlement of the twelve-week strike that had halted production of Aqua Nuchar activated carbon will not automatically ease the supply situation, warned the Industrial Chemical Sales Div., West Virginia Pulp & Paper Co. The two to three months' supply in warehouses, normally maintained to meet emergency needs, was exhausted by the long strike, which was settled on November 16. Until these stocks are built up again, it may be difficult to meet unusual demands and still supply routine needs. The company has requested its customers to utilize the product as efficiently as possible, and has pledged itself to distribute supplies equitably, while working as rapidly as possible to restore full service.

Mark D. Hollis has been appointed deputy chief of the Bureau of State Services in the Public Health Service. In addition to his new functions, which involve helping to administer a number of federal-local government cooperative programs, he will continue as chief sanitary engineering officer.

Now that "big business" is going to take over in January, water works men better get hep. After all, water is big business, too—probably the biggest business of all, with daily production these days running to more than 170 billion gallons, nearly 750 million tons, more than 1,000 gpd per capita. What if that includes industrial and irrigation water as well as public supplies, they're all the same business. Perhaps even unfortunately so, for with more and more irrigation on tap and with industrial use expected by the Paley commission to increase from its present 80 bgd to 200 bgd by 1975, water workers had better establish their claims now or they may be *getting* the business by that time.

(*Continued on page 4*)


An Announcement
WELSBACH
of vital interest to
the water works field . . .
After January 1, 1953, the water works industry will find all its requirements for water works service bronze met by a new, well-rounded line!
The Welsbach Corporation, Kitson Valve Division, has purchased from the A. P. Smith Manufacturing Company, their designs, patterns and tooling for water works service valves and fittings. Welsbach-Kitson has also purchased Smith Corporation Tapping Machine, the safest, most compact, most economical available today. The inclusion of these Smith products with Welsbach-Kitson service bronze joins two lines of quality—developed through the years by both of these old-established manufacturers of superior valves and fittings.
In addition to standard stock items, many patterns will be available on special order. Send now for the new combined catalog with its complete picture of the enlarged Welsbach-Kitson water works line . . . the line of Quality, Economy, Dependability.
WELSBACH
THE WELSBACH CORPORATION
Kitson Valve Division
1500 Walnut Street
Philadelphia 2, Pa.

(*Continued from page 2*)

From 30 years to life for some 200 AWWA members during the past year has been a matter of terminology rather than term. Properly, the induction of senior members into the newly established grade of Life Member has been the cause for celebration at section meetings throughout the Association, as certificates of long and loyal support have been presented. Among the lifers, twenty antedate 1910 in starting their sentences:

Sept. 1893	Emiel A. Croll, Orlando, Fla.	July 1907	Theodore Horton, Sandwich, Mass.
June 1902	Harold T. Havill, West Palm Beach, Fla.	July 1907	F. F. Longley, East Orange, N.J.
June 1903	Charles M. Horner, East St. Louis, Ill.	July 1907	Fred B. Nelson, Katonah, N.Y.
June 1906	Irving C. Bull, Middletown, N.Y.	July 1907	Ermon M. Peck, Hartford, Conn.
July 1906	E. V. French, Andover, Mass.	May 1908	Charles A. Emerson, New York, N.Y.
July 1906	T. B. Hunter, San Francisco, Calif.	May 1908	Andrew J. Provost, Darien, Conn.
July 1906	Elbert E. Lochridge, Springfield, Mass.	June 1908	William H. Lovejoy, Louisville, Ky.
July 1906	Samuel P. Senior, Bridgeport, Conn.	Apr. 1909	George B. Bassett, Buffalo, N.Y.
July 1907	George R. Ellis, Canandaigua, N.Y.	Apr. 1909	Warren U. C. Baton, Pittsburgh, Pa.
July 1907	Samuel A. Greeley, Chicago, Ill.	Oct. 1909	Carroll P. Bassett, Summit, N.J.

Not to let their seniority go by default, eight Honorary Members, too, can claim 1910 as merely another decade maker in their AWWA histories:

May 1900	James M. Caird, Troy, N.Y.	July 1906	Sheppard T. Powell, Baltimore, Md.
June 1903	M. N. Baker, Upper Montclair, N.J.	July 1907	Charles B. Burdick, Chicago, Ill.
June 1903	Beekman C. Little, Rochester, N.Y.	July 1907	Charles G. Hyde, Berkeley, Calif.
June 1906	Edward Bartow, Iowa City, Iowa	May 1908	Frank E. Hale, Southern Pines, N. C.

Just think of how much water under how many bridges (even dental) themby represented.

Harvey Whipple, who retired last July 1 as Secretary-Treasurer of the American Concrete Institute after having managed the organization's affairs for 32 years, died on September 6 at his home in Northville, Mich.

Lester E. Demler, sales engineer for Wallace & Tiernan Co., Inc., has been made manager of the newly established Chemical Feeder Dept. of the company. He has been with the firm since his graduation from Case Inst. of Technology in 1935.

(*Continued on page 6*)

American Concrete Cylinder Pipe for Higher Pressure Service

American Centrifugal Pressure Pipe for Low and Moderate Operating Heads

Wherever Pressure Conditions Permit . . . Different Classes of American Reinforced Concrete Pressure Pipe Can Be Combined in the Same Water Transmission Line

Here's a typical example of the ability of American to meet specific project requirements . . . to give you a carefully laid out and engineered pipe line.

. . . with Greater Economy in Cost!

You know that reinforced concrete pressure pipe gives you the strength of steel and the permanence of concrete . . . with reductions in initial cost, lower installation costs, sustained capacity, and trouble-free service. Four classes of reinforced concrete pressure pipe are available to meet varying requirements. So why not use the proper combination of these classes of pipe, where pressure ranges differ, to meet the needs not only of high pressure service but the needs of intermediate and low pressure service as well?

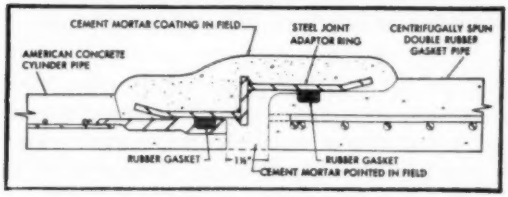
You'll find it the most economical way to plan a major capital investment. . . .

. . . with Greater Savings in Critical Materials!

The conservative design principles of reinforced concrete pressure pipe are such that economical use may be made of steel and concrete to meet design requirements with appreciable savings in critical materials.

So . . . if you find that the pressure ranges in your line are going to differ widely, give us the opportunity to show you how the combination of different classes of American reinforced concrete pressure pipe can save you money.

How American Concrete Cylinder Pipe Is Joined To American Non-Cylinder Pressure Pipe



A simple adaptor ring provides the transition between the spigot ends of two different classes of pipe. In all classes of reinforced concrete pressure pipe manufactured by American, the rubber gasket is confined by a joint ring to a definite groove in the spigot end of the pipe, thus assuring the most positive and safest use of the gasket as a water seal under all normal operating conditions.

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(*Continued from page 4*)

Texas abundance is so characteristically obvious, or obviously characteristic, that its current deficiency of water is being billed as an oversupply of dryness. And, as such, this result of a three-year drought that has far outdried New York's wither weather of 1949–50 is already getting top billing. Inasmuch as oil anywhere just naturally comes out on top, it has taken some mighty serious denaturalization to do that trick, but this month's tale of a driller at Lockhart going through a gusher to find a flusher is a sign of the times. As a matter of fact, news that Dallas is imposing fines of $50 to $200 for auto washing, lawn watering, and faucet dripping is merely another indication that Texans are now pushing all stoppers to conserve what supply they have of this newly most precious liquid. About the only idea from the New York drought bout that they haven't adopted is that sign in a bank's washroom reading: "The Management Requests Depositors to Spend Water Like Money." They also fear flood!

Not just Texas either, but the rest of the Southwest as well is having much more than its share of the woes of waterlessness this year. Sharing the headlines with the story of the Southwest Section's 41st annual meeting in Tulsa, Okla., last month, was the news that this year was racking up record dryness for the area. And unless it wets on the Northeast between the writing and the reading of this predictiveness, they'll be no "Tumblers for Texas" to repay the "Buckets for Broooklyn" that brought a tank truck of water from the oil state to the erl city in the desiccation of 1949.

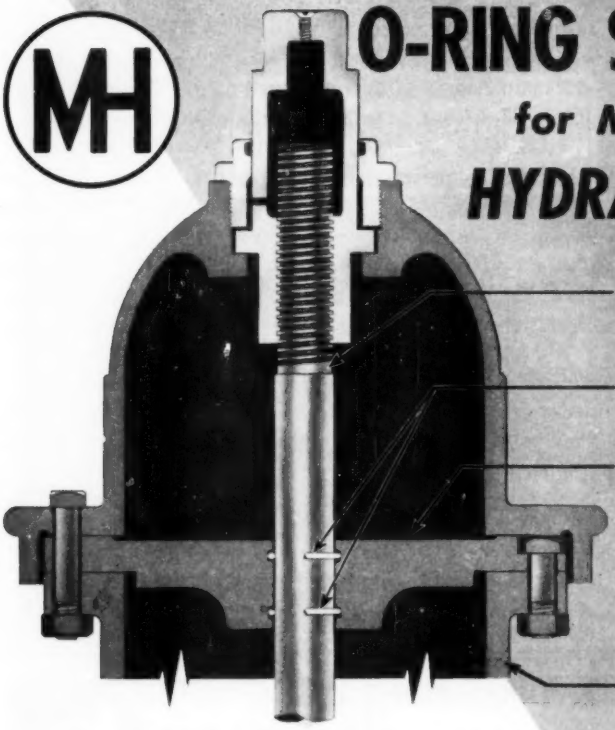
All in all, despite the Saturday-Sunday washouts that in the earlier months threatened "The Year of Lost Weekends," 1952 has been anything but all wet. And as a resolution for 1953, we can suggest to the weatherman that he vow to do his part in making the distinction between water works reservoirs and water works bank accounts a little clearer than it is fast becoming.

Drydom elsewhere has made Carlisle, Ky., radically conservative of its dwindling water supply. Attacking the problem on a straight supply and demand basis, the members of the city council boosted the price from 60 cents to $5 per thousand gallons as a means of cutting consumption. What they forgot, of course, was that even at that figure water was the biggest bargain in town, and if they were to follow through on their principle they would probably end up with most of their people thirsty, unwashed, or emigrant. But what we want to see is what price water when it rains!

Water saving through minimizing the washing of photographic prints is being urged upon film processors as a selling point, thus proving that even a manufacturer of photographic solutions can be conservation-conscious. The product for which the claim is made is BFi No. 30, a hypo neutralizer produced by Brown-Forman Industries of Louisville, Ky.

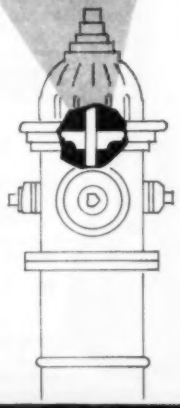
(*Continued on page 8*)

M&H O-RING SEAL for M&H HYDRANTS



M & H Hydrants can be furnished with Rubber O-Rings Seals if desired. The Seal Plate and O-Rings replace the conventional design of stuffing box, gland and packing. O-Ring Seal Plates can also be supplied for hydrants in service.

The Seal Plate contains two rubber O-Rings These O-Rings Seals are tight and leakproof and require little or no maintenance. Both O-Rings are made of a special compounded rubber plastic which does not deteriorate. Replacement of the O-Rings is a simple and easy operation, however, if it should become necessary. For complete information, write or wire M & H VALVE and FITTINGS COMPANY, Anniston, Alabama.



M&H PRODUCTS FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION

(Continued from page 6)

William E. Thrasher, superintendent of the Westchester Joint Water Works No. 1, died on October 29 as the result of an accidental fall. He had been up all night on a main cleaning job and slipped off his own porch after his return home. Only 57, he had been head of the utility since 1934.

William W. Pointer, superintendent and general manager of the Troy, Ala., Light, Water & Gas Dept., died on Oct. 30, 1952. Last summer he completed his fiftieth year in the water works field. He joined AWWA in August 1929 as a member of the Southeastern Section, and was elected its chairman in 1944. He transferred to the Alabama-Mississippi Section when it was organized and had been a very active member of that group.

Timothy J. Keliher, retired head of the Williamsport, Pa., Water Authority, died on October 24 at the age of 83, after a short illness. He had joined the Williamsport Water Co. in 1895 and had served in a variety of posts, becoming superintendent in 1917. In 1932 he took on the additional duties of manager, and held both posts until his retirement in 1948, a year after the reorganization of the utility as an authority.

(Continued on page 12)

AMONG WATER WORKS MEN

THE HEAVY-DUTY
ELLIS
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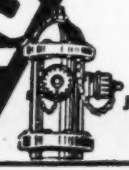

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An ounce of proof is

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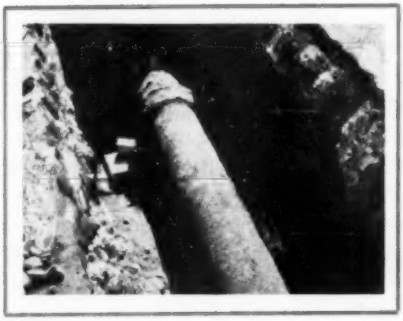
For a permanent installation, such as a new water supply system, or extensions to an existing system, experienced engineers rarely take chances on a substitute for cast iron pipe. They know that 96% of all cast iron pipe, 6-inch and larger, laid in 25 representative cities over the past 130 years, is still in service. On the other hand, it is a fact that more than a few communities have had to replace water distribution systems, constructed with substitue pipe, long before the bonds issued against them were paid for.

The long life and low maintenance cost of cast iron water mains—and the consequent tax savings to the public—are matters of record. An ounce of *proof* is worth a pound of *claims!*



One of a number of cast iron water mains which have been in service in New York City for more than a century. Over 35 other cities have century-old cast iron mains in service.

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America's No. 1 Tax Saver

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(*Continued from page 8*)

Hellfire is the newest answer to the problem of using the sea as a source of fresh water for municipal supply—hellfire as harnessed by an aircraft engineer who must have mistaken a handbasket for a cockpit to get involved in the problem anyway. Be that as it may, Russell le Vesque, who appears to have gone from the heights to the depths in his 32 years, is busy these days touring California cities to sell them his method of producing fresh water from the sea for populations of 50,000 at a cost of $25 per acre-ft. Features of the le Vesque system are: an intake pipe into the sea to draw salt water into a series of condensers where it is warmed a little before being shot down a shaft to 15,000 ft below the earth's surface where temperatures of 360 F heat it well above the boiling point, creating pressures which bring the superheated water back to the surface where it goes into a steam generator and then, as steam, back into the original series of condensers where it is condensed into pure water. The fuel—basic cost problem of all other methods—is free as the very devil. And, of course, if the thing doesn't work, there's always a chance that a 15,000 ft hole even in California these days will strike water somewhere.

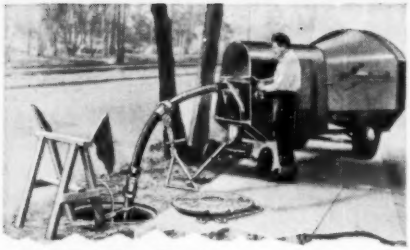
Incidentally, the consulting physicist in developing this hot idea was Dr. William E. Frye.

Academic is what all this distillation discussion is going to be unless water works men do something quick about claiming a fair share of the sea. Not only projects for ocean gold mining and the extraction of other metals, but the beginnings now of what is being called sea farming has us especially worried. The Scottish Institute for Seaweed Research, for instance, has demonstrated the possibility of increasing both marine plant and fish production by the use of fertilizers. Flounders feeding in fertilized waters have grown approximately four times as fast in length and sixteen times in weight as those not transplanted to such an environment. And from Batelle Institute in Columbus, Ohio, we have the prediction not only of bigger fish, but more petroleum from beneath the ocean's bottom and increasing amounts of seaweed derivatives for the food and pharmaceutical industries as a result of such sea science. Add to all this industry, the amount of sea required for transportation and recreation, and you'll begin to understand why we're anxious that serious sea needers grab their hunk of ocean now before it's all used up or full of fertilizer.

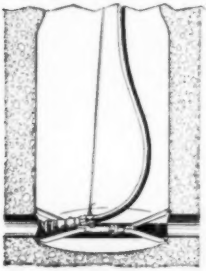
R. H. Corey, consulting engineer of Portland, Ore., has retired from the active practice he has maintained since 1930 in Portland, turning it over to Clark & Groff Engrs. of the same city. In addition to his consulting work, he had been state engineer in charge of construction in both Oregon and Washington, and at one time was manager and engineer for eight privately owned water utilities.

(*Continued on page 14*)

"FLEXIBLE" *Exclusives* THAT *Revolutionized* SEWER CLEANING



Since 1932 FLEXIBLE has led in pioneering improved sewer cleaning methods and equipment. Here are today's most important "FLEXIBLE" musts!



The
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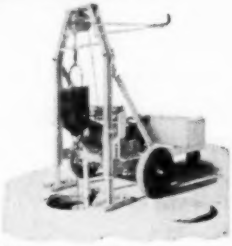
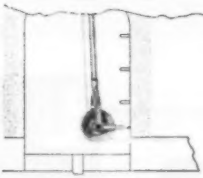
A mechanical marvel that does all rodding with one man and a helper. Pushes, turns, pulls . . . pulls back loads and "rods in" for more.





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OF PIPE CLEANING TOOLS AND EQUIPMENT

(*Continued from page 12*)

An underwater apartment in New York City rated a big splash in the Sunday *Times* magazine section recently as a means of reducing the current overcrowding of the city. Not as antisocial as it sounds, either, the story was one of a duplex closer to the clouds than to Davy Jones abode, the water being that entanked at the top of one of New York's tall apartment buildings. Much was made of the fact, too, that in addition to the other comforts provided by water, this apartment, created by bricking in the area between the roof of the building and the bottom of the tank, benefited by its insulating value both in summer's heat and winter's cold. All of which ought to suggest an additional source of revenue for any system provided with an elevated tank. And if we know our tank manufacturers, we won't have long to wait for the first million-gallon model complete with four-story dumbwaiter and doorman.

Promotions made in the sales division of Mueller Co. include that of Robert H. Morris, sales manager, to General Sales vice-president; Robert K. Levey, promotional sales engineer, to General Sales assistant vice-president; and Robert P. Jett, salesman, to director of sales planning.

(*Continued on page 16*)

LIMITORQUE
VALVE CONTROLS

From coast to coast, hundreds of LimiTorque Controls are in service in water works and sewage disposal plants for automatic or remote operation of valves up to 120 inch diameter. Why is acceptance so widespread? Because LimiTorque Operators are designed to provide dependable, safe and sure valve actuation at all times.

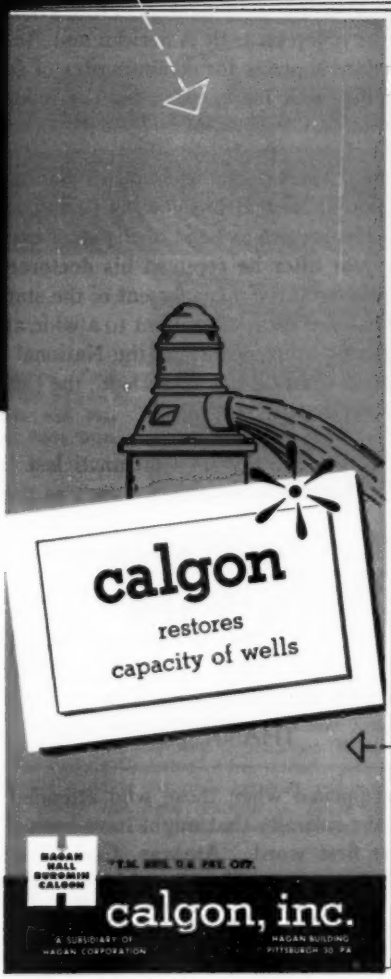
LimiTorque is self-contained and is applicable to all makes of valves. Any available power source may be used to actuate the operator: Electricity, water, air, oil, gas, etc.

A feature of LimiTorque is the torque limit switch which controls the closing thrust on the valve stem and prevents damage to valve operating parts.

Write for Catalog L-50 and get the details

PHILADELPHIA GEAR WORKS, Inc.
ERIE AVENUE and G STREET, PHILADELPHIA 34, PA.
New York • Pittsburgh • Chicago • Houston • Lynchburg, Va.

get your copy of this new booklet



CONTENTS

- Well cleaning with Calgon*
- How Calgon works
- Procedure for well cleaning
- Cleaning domestic wells
- Cleaning large diameter wells
- Reports from the field
- Threshold treatment

*T.M. REG. U.S. PAT. OFF.

Reports from the field about increased well capacity after cleaning with Calgon go like this:

"Calgon cleaning more than doubled previous capacity of wells."

"Specific capacity increased 89% by Calgon cleaning."

For your free copy of the booklet, clip the coupon.

CALGON, INC.
Hagan Building, Pittsburgh 30, Pa.

Please send me your bulletin "Calgon Restores Capacity of Wells."

NAME_____

POSITION_____

COMPANY_____

STREET AND NUMBER_____

CITY_____ ZONE____ STATE_____

JAW-12

(*Continued from page 14*)

"Hey, Mac!" will usually draw some kind of attention from almost everyone within earshot, being one of those all-American appellations which requires a "Yeah, you!" to make an identification specific. But, as an all-American Water Works Co. appellation these days, it is quite specific —specifically Eleuterio C. Macalalag, Chief Water Works Engr., Bureau of Public Works, Philippine Government, Manila, who is now spending a six-month training and observation visit with "American" under Mutual Security Administration sponsorship. Mac, a 1924 civil engineering graduate of Purdue, is busy now picking up the scoop on both American and American practice in operating gravity surface supplies for communitites of 6,000 to 10,000 population, his responsibility back home. So, for the next six months at American, it'll be "Hey, Bud!"

Willem Rudolfs has retired as chairman of the Dept. of Sanitation of the Agricultural Experiment Station at New Brunswick, N.J., and is returning to his native Netherlands. His service as head of the state experiment station dates back to 1922, a year after he received his doctorate at Rutgers University, which is associated with the management of the station. In addition to his regular duties, he has served as consultant to a wide array of governmental and quasi-governmental units, including the National Resources Council, The National Research Council, the War Dept., the League of Nations, and a number of states and state departments.

What a time—at the Ohio Section Meeting in Cincinnati last September—what a time, that is, for the hotel to post a notice such as this in every room:

NOTICE

THERE WILL BE A WATER SHUTDOWN AFTER MIDNIGHT UNTIL 6:00 A.M. PLEASE MAKE SURE THAT ALL TUB AND BASIN FAUCETS REMAIN CLOSED

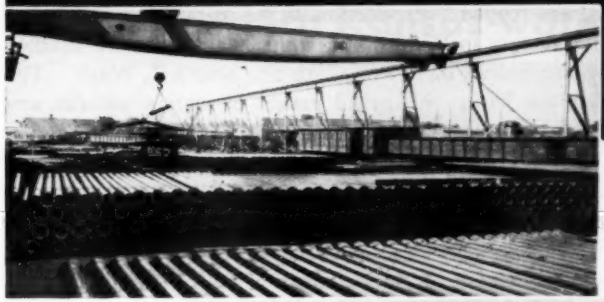
THANK YOU

Speculating on what might have happened when those who attended the meeting got thirsty, we considered the calamity that might have been if the "T" had been dropped out of that first word. Anyway, Carl Eberling, superintendent of the local water department, disclaimed all knowledge, responsibility, and even credit!

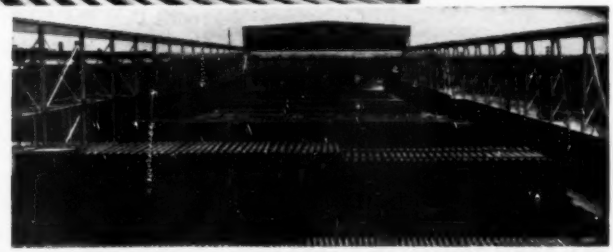
John E. Jackson, president of Pittsburgh-Des Moines Steel Co., has been elected president of the American Inst. of Steel Construction. He had been a member of the board of the institute since 1947 and has just completed a two-year term as first vice-president of the organization.

(*Continued on page 18*)

Prompt Shipment
CAST IRON PIPE



Pipe Foundry Shipping Yards at McWane Cast Iron Pipe Co., Birmingham, Ala.



Shipping Yards Pacific States Cast Iron Pipe Co., Provo, Utah.

IF YOU'RE IN A HURRY, PHONE
McWANE-PACIFIC

Prompt, quick shipment by rail or truck now is available from our stock yards of McWane-Pacific DeLavaud Centrifugal Cast Iron Pipe in sizes 4" and larger, 18' lengths.

Furnished either tar coated or cement lined and you may have your choice of open-bell Bell-and-Spigot, precalked Bell-and-Spigot, or Mechanical Joint.

The Federal Government has recently placed Cast Iron pressure pipe and fittings under building materials category and your former 45-day limitation on pipe inventory has been changed to allow inventory based on practical working requirements. For quick shipment, telegraph or telephone our nearest Sales Office.

McWANE Cast Iron Pipe Company
Birmingham, Ala.
Pipe Sizes 2" thru 12"

Sales Offices

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New York 4, N. Y.	80 Broad Street
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Dallas 47, Texas	3200 Maple Avenue

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Pipe Sizes 2" thru 24"

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San Francisco 4, Cal.	235 Montgomery St.
Portland 4, Oreg.	501 Portland Trust Bldg.
Salt Lake City	Waterworks Equip't Co.
Seattle 4, Wash.	Smith Tower Bldg.

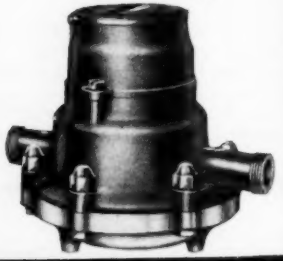
(*Continued from page 16*)

A "windshield wiper" for meters has been invented by Carl J. Mitchell of the Seattle Water Dept. to clear fog or condensation from the inside of the meter glass. The device has been installed experimentally on a group of Seattle meters for the better part of a year, and thus far has succeeded in permitting meter readers to obtain a clear and accurate reading whenever the glass was fogged. Production of the meter glass wiper has been arranged with a factory in Illinois, but inquiries and sales are handled by the Mitchell Product Sales Co., 641 W. 79th St., Seattle 7, Wash. The designer claims that the wiper will fit all makes of meters without any changes in the case or cover, and that installation is as simple as changing a glass.

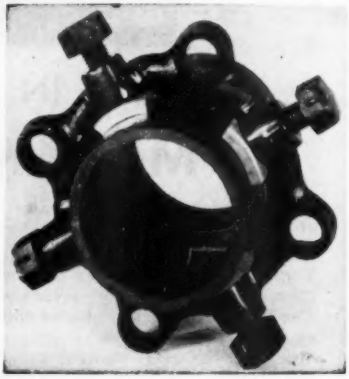
A woman's curves have been proved of very little interest to the water works man—professionally, that is. Otherwise, of course, otherwise! But sticking to the curve, we have it on the authority of the recent clinical congress of the American College of Surgeons that the fat which creates curvaceousness contains very little water, whereas ugly male muscle is saturated with it. Drought or no, though, we gotta pick Ava Gardner over Frankie Sinatra every time.

American Meter
INTERCHANGEABILITY
Cuts Costs

Individual parts as well as entire assemblies of Buffalo AMERICAN Water Meters can be interchanged. Repairs are made quickly at low cost. Stocks held at a minimum. Write for details.



BUFFALO METER COMPANY
2914 Main Street
Buffalo 14, New York



ANCHORED CLAMP for MECHANICAL JOINTS

Also CI-60 charcoal cast iron bolts for mechanical joints; bell-joint Leak Clamps and Gasket Sealer Compound.

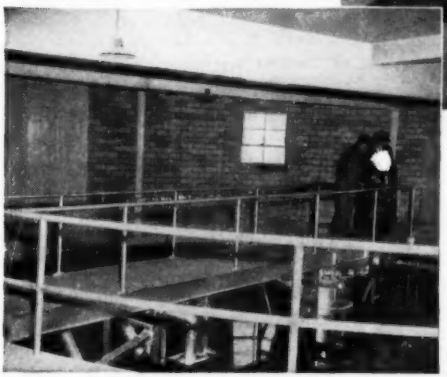
Write for information

H. Y. CARSON COMPANY
1221 Pinson St. Birmingham, Ala.

Sturdy INERTOL paints specified

at two modern Kansas water works

Easy-to-clean **TOREX** enamel protects and beautifies the concrete walls of filter beds at the Russell, Kansas, Water Works. Piping, walls and ceilings get **Ramuc Utility,** a chlorinated rubber-based enamel.



At the Hays, Kansas, Water Works, **TOREX** Seagreen #304 guards submerged concrete surfaces. **TOREX's** pore-free surface cleans quickly, prevents mudball formation. Nonsubmerged surfaces take long-wearing **Ramuc Utility.**

Wilson & Co., Consulting Engineers of Salina, Kansas, specified Inertol Paints for wear, savings and looks

In specifying coatings for both of these Water Works, *Wilson & Co.* wanted durable paints that would provide the long-haul economy which means complete customer satisfaction. And that's why Inertol paints rated first on their list. Developed especially for water works application, Inertol coatings far exceed requirements for hardness, elasticity, inertness and water-resistance. And *Wilson & Co.* knew that the Inertol line had proved its superiority in thousands of installations throughout the United States.

Inertol Field Technicians will gladly fill you in on all the facts — help choose the Inertol coatings to fit your precise needs. Or send today for our free Painting Guide. If you're a Specification Writer, Design Engineer, Plant Superintendent or Contractor, you'll refer to it time and again. Write for your free copy *today!*

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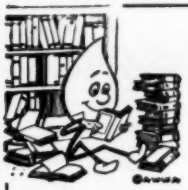
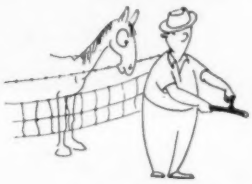


The Reading Meter

You Never Miss the Water . . . : *A few pointers on ground water supplies. Geological Survey Div., Michigan Dept. of Conservation, Lansing, Mich. (1952) 48 pp.; paperbound; 15¢*

From hydrologic cycle to falling water level in fifteen minutes of cartoon and comment that tell the whole story and tell it in terms that can be understood by the layest of layman. From the words of Jean L. Slaughter and the illustrations of James M. Campbell, any present or prospective well owner—industrial, domestic, or otherwise—can profit painlessly. Not only because the booklet says of dowsing:



Even in this age of science, faith in "water witching" persists among many people. It has no scientific basis. For practically all our other needs we insist on factual scientific treatment, so why not for water?—our most vital need.

but because it has the good sense to adapt its style to its audience, we believe it a most effective means of selling private water supplies. Come to think of it, though—why sell *private* supplies?

The Industrial Utility of Public Water Supplies in the West South-Central States, 1952. *E. W. Lohr, J. R. Avrett, B. Irelan, G. A. Billingsley, & T. B. Dover. Circular 221, Geological Survey, Washington 25, D.C. (1952) 123 pp.; paperbound; free*

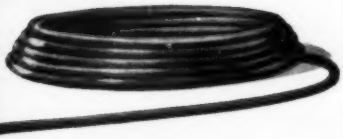
This fourth report of a contemplated series of nine (*see* October Journal, P&R p. 92) summarizes basic information about the waters supplied by public utilities in Arkansas, Louisiana, Oklahoma, and Texas.

Hydraulic Research in the United States. *Helen K. Middleton & Sonya W. Matchett, ed. Miscellaneous Pub. 205, National Bureau of Standards (1952) 200 pp.; paperbound; $1.00 from Supt. of Documents, Government Printing Office, Washington 25, D.C.*

This volume is an index to hydraulic research projects currently being conducted by 100 hydraulic and hydrologic laboratories in the United States and Canada. Cross-indexed by subject and agency.

(*Continued on page 22*)

Only Carlon



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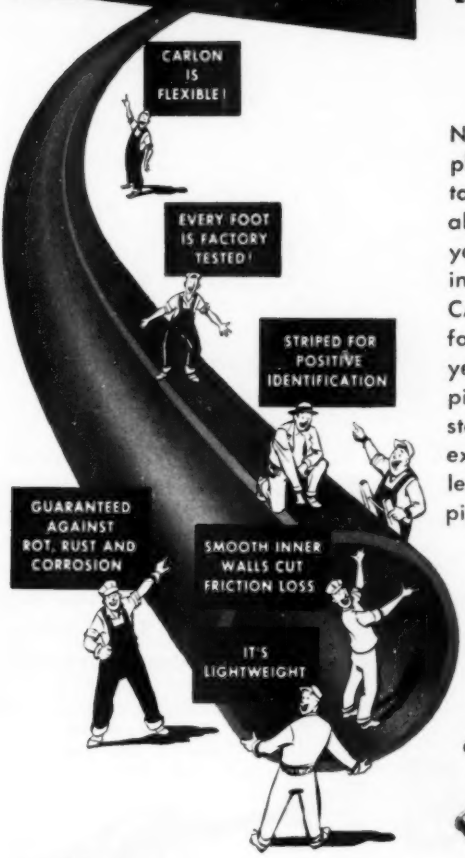
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The Reading Meter

(Continued from page 20)

Surface Preparation Specifications—SSPC-SP 1-9. *Steel Structures Painting Council, 4400—5th Ave., Pittsburgh 13, Pa. (1952) 21 pp. in 9 paperbound booklets; $1.00 per set or 25¢ per individual booklet*

These specifications for preparing steel surfaces were approved on August 28, 1952, by the Steel Structures Painting Council, an organization in which nineteen agencies or organizations—AWWA among them—are represented. The individual specifications are: 1. Solvent Cleaning; 2. Hand Cleaning; 3. Power Tool Cleaning; 4. Flame Cleaning of New Steel; 5. Blast Cleaning to "White" Metal; 6. Commercial Blast Cleaning; 7. Brush-Off Cleaning; 8. Pickling; and 9. Weathering and Cleaning.

A "First Book" on Fire Safety in the Atomic Age. *Horatio Bond. National Fire Protection Assn., 60 Batterymarch St., Boston 10, Mass. (1952) 72 pp.; $3*

Conflagrations, fire storms, and ways of meeting them (which is where water comes in) are discussed by the NFPA chief engineer.

Underground Water Pollution Resulting From Waste Disposal. *California Regional Water Pollution Control Board, Los Angeles Region (541 S. Spring St., Los Angeles 13, Calif.) and Santa Ana Region (1952) 16 pp.; paperbound; free*

A nontechnical explanation designed for circulation through local civic groups, this booklet is intended to orient the layman and industrialist and start him on the right track in the pollution abatement campaign.

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Machine blended for perfect jointing performance
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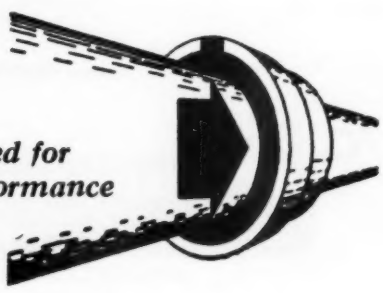
SPRING VALLEY NEW YORK


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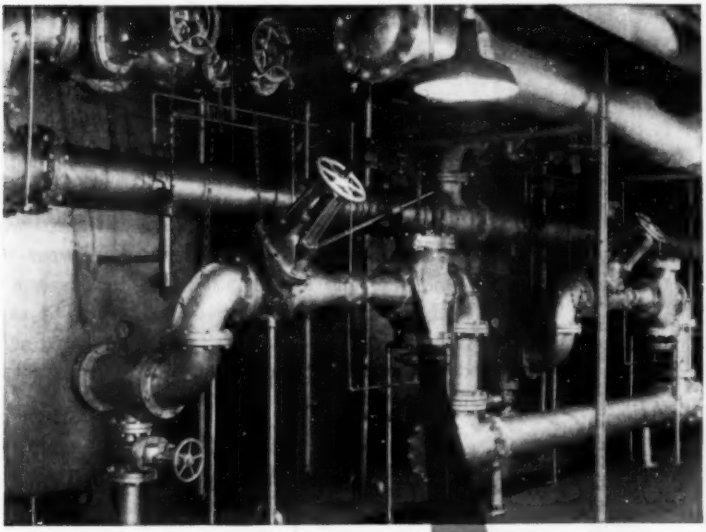
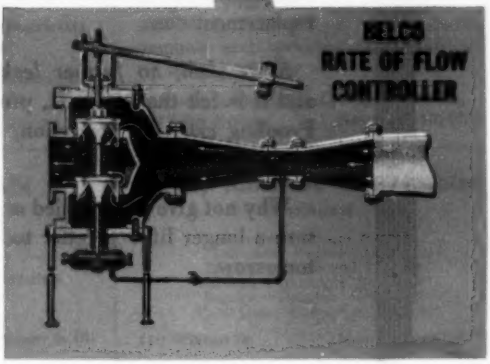
BELCO horizontal filters provide low cost treated water

INCORPORATE AUTOMATIC BELCO RATE OF FLOW CONTROLLERS FOR OPTIMUM CONTROL



Belco provides automatic or manual filtration equipment for any flow capacity. The experience of Belco engineers in process control is unmatched. The Belco Rate of Flow Controller insures constant rate of flow under varying pressure conditions. The unit is sensitive, accurate and designed for low head loss. More information? Ask the Belco man!



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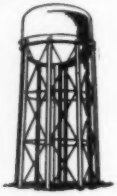

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In 1943, a small New England town was faced with the problem of replacing a condemned 57 year old water tank. Serious leaks had begun to develop in 1935, and had continued despite applications of various coatings over a period of 8 years. It was finally decided to replace the tank because of its leak record, though the cost was high.

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Membership Changes

NEW MEMBERS

Applications received October 1 to October 31, 1952

Allen, Lorin Blanchard, Partner, Allen & Hoshall, 65 McCall Ave., Memphis, Tenn. (Oct. '52) *P*

Anderson, Joseph Edward, Jr., Director of Public Works, Arroyo Grande, Calif. (Oct. '52) *MRP*

Armstrong, Robert E., Engr., Metropolitan Water Dist. of Southern California, 306 N. 3rd St., Los Angeles 13, Calif. (Oct. '52)

Backlund, Brandon H., Partner, Backlund & Jackson, 4924 Poppleton St., Omaha, Neb. (Oct. '52) *P*

Baldwin, Brooks, Chief Operator, Filter Plant, St. Petersburg, Fla. (Oct. '52)

Benson, Wallace F., Cons. Chemist, Wallace F. Benson Assoc., Box 1026, Indianapolis, Ind. (Oct. '52) *P*

Bergstedt, Dale Clifford, Lab. Mgr., Culligan Zeolite Co., Box 431, San Bernardino, Calif. (Apr. '52) *P*

Boerner, G. W., Mgr., Culligan Soft Water Service, 353 W. Josephine St., San Antonio, Tex. (Oct. '52) *P*

Bosio, Joseph Francis, Deputy City Attorney, Dept. of Water & Power, 207 S. Broadway, Los Angeles 54, Calif. (Oct. '52)

Bradley, Earl C., Jr., Vice-Pres., Utility Supply Co., 5828 Harvey Wilson Dr., Houston, Tex. (Oct. '52) *M*

Carpenter, Alden W., Sales Repr., Builders-Iron Foundry, 221 Sexton Bldg., Minneapolis, Minn. (Oct. '52)

Burdick, R. L., Salesman, Mueller Co., Box 1172, Orlando, Fla. (Oct. '52) *D*

Burns, Ross J., Salesman, Water Works Supply Co., Monadnock Bldg., San Francisco, Calif. (Oct. '52)

Candage, Byron Whitefield, Asst. San. Engr., Bureau of San. Eng., State Health Dept., 22 N. 9th St., Richmond, Va. (Oct. '52) *MRP*

Chambers, Alex H., Sales Engr., Alan A. Wood, Inc., 618 Du Pont Circle Bldg., Washington 6, D. C. (Oct. '52)

Coffey, L. M., Culligan Soft Water Service, 921 S. 7th Ave., Sioux Falls, S. D. (Oct. '52)

Cole, Charles W., II, Charles W. Cole & Assoc., E. LaSalle Ave., South Bend, Ind. (July '52)

Coleman, Lawrence Alden, San Eng. Asst., San. Eng. Div., Dept. of Water & Power, 207 S. Broadway, Los Angeles, Calif. (Oct. '52) *MRP*

Crawley, J. W., Salesman, Hays Mfg. Co., 400 E. Main St., Arlington, Tex. (Oct. '52)

Degnan, James M., Assoc. Chem. Engr., Atlantic Refining Co., 3144 Passyunk Ave., Philadelphia, Pa. (Oct. '52) *RP*

Doust, Alfred I., Jr., Contractor, R.D. 1, Marietta, N.Y. (Oct. '52) *MRP*

Dudbridge, William K., Public Water Treatment Plant Operator, Lambertville Water Co., 31 Bridge St., Lambertville, N. J. (Oct. '52) *MRP*

Edgbert, W. D., Secy. & Treas., Water Well Supply, 11224 S. Norwalk Blvd., Norwalk, Calif. (Oct. '52) *MRP*

Everett, Clyde T., Asst. City Engr., City Engr.'s Office, Fayetteville, Ark. (Oct. '52) *MRP*

Farris, William L., Water Supervisor, E. I. du Pont de Nemours & Co., Charlestown, Ind. (Oct. '52)

Foote, Wayland I., Sr., Gen. Supt., Box 305, Fairburn, Ga. (Oct. '52) *MRP*

Fukutaki, William K., Civ. Eng. Asst., Dept. of Water & Power, Box 3669 Terminal Annex, Los Angeles 54, Calif. (Oct. '52) *M*

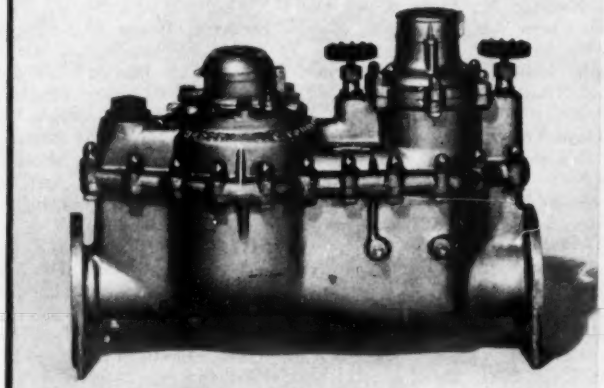
George, Rex, Maint. Engr., Water Plant, Fayetteville, Ark. (Oct. '52) *MRP*

Gordon, George F., Sales Engr., De Laval Steam Turbine Co., Trenton, N.J. (Oct. '52) *MR*

Graham, W. M.; *see* Oneonta (Ala.) Water Works Board

Grayson, David Duayne, San. Eng. Asst., Dept. of Water & Power, 207 S. Broadway, Los Angeles, Calif. (Oct. '52) *MRP*

(*Continued on page 32*)



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Gunn, William L., Water Works Supt., Yanceyville San. Dist., Yanceyville, N.C. (Oct. '52) *M*

Hart, John C., Manufacturer's Repr., Neptune Meter Co., North Kansas City, Mo. (Oct. '52)

Heagler, Arthur E., Cons. Engr., 520 National Bldg., Pine Bluff, Ark. (Oct. '52) *MRP*

Herr, Claude, Supt., Water Works, South Whitley, Ind. (Oct. '52)

Hillmer, Fred H., Water Supt., Orange Grove, Tex. (Affil. Oct. '52)

Hines, H. B.; *see* Sanford (N.C.)

Hopper, R. J., Pres., Trask Well Co. Ltd., Box 550, Stellarton, N.S. (Oct. '52)

Hornbeak, William Robert, Secy.-Treas.-Mgr., Big Bear City Mutual Service Co., Box 25, Big Bear City, Calif. (Oct. '52) *MR*

Howard, Norman R., Plant Supt., Old Hickory Chem. Co., Box 4136, Richmond, Va. (Oct. '52) *MP*

Hundevadt, Robert C., Eng. Designer, Alexis B. Kononoff, 620 N.W. 32nd St., Miami, Fla. (Oct. '52) *RP*

Inman, Lloyd Vernon, Asst. Mgr., Water Dept., Box 659, Longview, Wash. (Oct. '52) *MP*

Kadoya, Shozo, Student, San. Eng. Dept., The Johns Hopkins Univ., Baltimore 18, Md. (Jr. M. Oct. '52) *P*

Keeton, John Richard, Jr. Engr., Univ. of Southern California Eng. Center, Los Angeles 7, Calif. (Oct. '52) *RP*

Kirkpatrick, Edward Stuart, Field Engr., Infilco Inc., 3105 Roswell Rd., N.E., Atlanta 5, Ga. (Oct. '52) *P*

Knauss, J. P., Salesman, Electro Rust-Proofing Corp., 1229 W. Washington Blvd., Chicago, Ill. (Oct. '52)

Larson, Andrew J., Larson Tank Co., 4355 Pleasant Ave., Minneapolis 9, Minn. (Oct. '52) *R*

Lenderink, Andrew, Cons. Engr., 221-222 Commerce Bldg., Kalamazoo, Mich. (Oct. '52)

Lower Bucks County Joint Munic. Authority, C. Donald Moyer, Chairman, Route 13, Tullytown, Pa. (Munic. Sv. Sub. Oct. '52)

Martin, Basil Clay, Water Plant Operator, Munic. Water Works, 117—2nd St., Elkins, W.Va. (Oct. '52) *MP*

Marthaus, H. F., Vice-Pres., Warren Chemical Co., Inc., Box 225, Indianapolis 6, Ind. (Oct. '52) *P*

Masuda, Terry Teruhiko, Asst. Public Health Chemist, State Dept. of Public Health, Sanitation Lab., 1975 Shattuck Ave., Berkeley, Calif. (Oct. '52)

Matthews, Kenneth Cragg, Sales Engr., Henry P. Thompson Co., 1717 Section Rd., Cincinnati 37, Ohio (Oct. '52) *P*

McClelland, George F., Supt. & Mgr., Water & Sewer System, Harrisburg, Ark. (Oct. '52) *M*

McCully, Lester R., Supt., Waterworks, Stellarton, N.S. (Oct. '52)

McCutchen, John William, Asst. Engr., Research Dept., United Gas Corp., Shreveport, La. (Oct. '52) *RP*

McGinnis, Olan W., Supt. of Constr., H. P. Pelton, 606 Crutcher St., Springdale, Ark. (Oct. '52) *MR*

Meranda, Norman E., Water Works Engr., RR 1, Box 58, Yellow Springs, Ohio (Oct. '52)

Methvin, Fliece M., City Engr., City Hall, El Dorado, Ark. (Oct. '52) *R*

Moyer, C. Donald; *see* Lower Bucks County (Pa.) Joint Munic. Authority

Mueller, Robert E., Mech. Engr., Paul B. Mueller Co., 1033 Metropolitan Life Bldg., Minneapolis, Minn. (Oct. '52) *M*

Murphy, William L., Asst. Supt., Water Dept., 101 City Hall, Sioux City, Iowa (Oct. '52) *M*

Myers, William C., Sales Repr., Worthington-Gamon Meter Div., Worthington Corp., Newark, N.J. (Oct. '52)

Neumann, Walter G.; *see* Neumann Co.

Neumann Co., Walter G. Neumann, Supt., 946 W. 69th St., Chicago 21, Ill. (Assoc. M. Oct. '52)

Noreen, Olaf S., Owner, Marietta Paint & Color Co., Box 1945, Charlotte, N.C. (Oct. '52) *M*

Oberholtzer, Marshall L., Pres., Oberholtzer Constr. Corp., 1650 Beeler St., Indianapolis, Ind. (July '52)

Oberndorfer, William P., Gen. Mgr., W. P. Oberndorfer & Son, 201 E. Plume St., Norfolk, Va. (Oct. '52)

Omans, Barkley G., City Mgr. & Engr., Buchanan, Mich. (Oct. '52) *M*

Onellion, Frank E., Geologist, U.S. Geological Survey, 522 E. 2nd St., Little Rock, Ark. (Oct. '52) *R*

Oneonta Water Works Board, W. M. Graham, Treas., City Hall, Oneonta, Ala. (Corp. M. Oct. '52)

Pate, Walter J., Supt., Water & Sewer Depts., Charleston, Ark. (Oct. '52) *M*

(*Continued on page 34*)

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Patterson, Edgar L., City Engr., Box 1181, Fort Lauderdale, Fla. (Oct. '52)

Peisch, William Kent, San. Engr. Asst., Dept. of Water & Power, 207 S. Broadway, Los Angeles, Calif. (Oct. '52) *P*

Phillips, Francis E., Box 9, Kokomo, Ind. (July '52)

Pickles, H., Sales Repr., R. G. Haley & Co., Claypool Hotel, Indianapolis, Ind. (Oct. '52)

Poulsen, Frank, Supt., Water Dept., City Hall, Santa Rosa, Calif. (Oct. '52)

Quiros S., Mario, Mgr., Cia. Constructora Orlich & Masis Ltda., Box 1285, San Jose, Costa Rica (Oct. '52) *MP*

Reeves, Robert C., San. Engr., Truman Schlup, 1401 Fairfax Trffy., Kansas City, Kan. (Oct. '52) *P*

Reutter, John G., Cons. Engr., 708 Federal St., Camden, N.J. (Oct. '52) *RP*

Rexer, William, Supt. of Repairs, New York City Dept. of Water Supply, Gas & Electricity, Kew Gardens, N.Y. (Oct. '52) *MRP*

Riegler, Leo J., 2170 Beidler St., Muskegon, Mich. (Oct. '52) *R*

Rosener, Leland S., Cons. Engr., 233 Sansome St., San Francisco 4, Calif. (Oct. '52) *P*

Ryckman, DeVere Wellington, Asst. Prof. of San. & Civ. Eng., Michigan State College, East Lansing, Mich. (Oct. '52) *MRP*

Sanford, City of, H. B. Hines, Jr., City Mgr., Sanford, N.C. (Corp. M. Oct. '52)

Stahl, Ervin H. A., Sales Engr., Layne-Northern Co., 2000 Turner St., Lansing, 6, Mich. (Oct. '52) *R*

Testa, Charles, Dist. Repair Supt., New York City Dept. of Water Supply, Gas & Electricity, 131–30—229th St., Laurelton 13, N.Y. (Oct. '52) *M*

Tillman, J. B., Jr., Supt., Water System, Whitehaven Utility Dist., Box 5416, Whitehaven, Tenn. (Oct. '52) *MP*

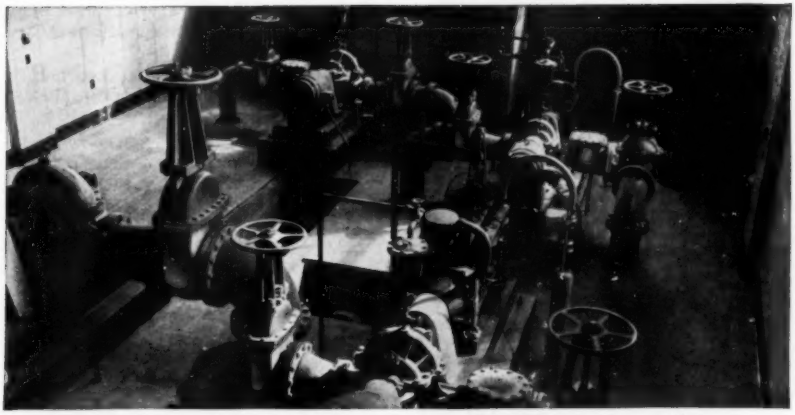
Trigeiro, William F., City Engr., Director of Public Works, City Hall, Atwater, Calif. (Oct. '52)

Waddle, Charles M., Engr., Kalamazoo Vegetable Parchment Co., RFD 1, Box 110, Galesburg, Mich. (Oct. '52) *R*

Watters, Frank F., Hydr. Engr., Utilities Div., State Public Utilities Com., State Bldg., Civic Center, San Francisco 2, Calif. (Oct. '52)

Weinstein, Byron, Civ. Eng. Assoc., Dept. of Water & Power, 207 S. Broadway, Los Angeles, Calif. (Oct. '52)

(*Continued on page 36*)



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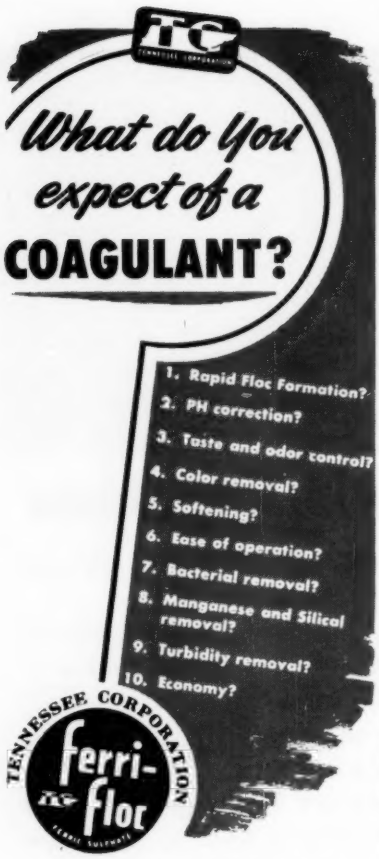

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Weller, Lloyd Wayne, Project Engr., Black & Veatch, 4308 Broadway, Kansas City, Mo. (July '52) *P*

Whitehair, Denzle Q., Sales Repr., Hays Mfg. Co., R.D. 1, Avonia Beach Rd., North Girard, Pa. (Oct. '52) *M*

Wilkas, Bert C., Constr. Engr., La Mesa, Lemon Grove & Spring Valley Irrigation Dist., 457 Charles Way Fletcher Hills, El Cajon, Calif. (Oct. '52) *M*

Yawn, Robert E., Operator, Water Dept., 3825 Milton St., West University Place, Houston 5, Tex. (Oct. '52) *M*

Yocum, Robert Lowry, San. Sales Engr., The Dorr Co., 1330 N. Industrial Blvd., Dallas, Tex. (Oct. '52) *MRP*

REINSTATEMENTS

Automatic Control Co., J. S. Williams, Vice-Pres., 1005 University Ave., St. Paul 4, Minn. (Assoc. M. Apr. '46)

Drake, Hal M., Dist. Engr., Wallace & Tiernan Co., Inc., 3500 W. 12th St., Little Rock, Ark. (July '49) *P*

Higgins, Frank T., Div. Engr., Water Dept., 3610 E. Spring St., Long Beach 6, Calif. (Oct. '44)

McCall, Malcolm McAndrew John, Chief Design Engr., Machinery Div., Dravo Corp., Dravo Bldg., Pittsburgh 22, Pa. (June '24) *RP*

Williams, J. S.; *see* Automatic Control Co.

LOSSES

Deaths

Augustus, A. Stewart, Asst. Supt., Louisville Water Co., 435 S. 3rd St., Louisville 2, Ky. (Apr. '47) *D*

Bartlett, Dan Tommy, Sanitarian Jasper-Newton Health Unit, 956 E. Milan, Jasper, Tex. (Jan. '51) *P*

Farquharson, Alex L., Gen. Mgr., Public Utilities, Brockville, Ont. (Mar. '24) *M*

Jenne, Lyle L., San. Engr., Bureau of Water, 825 City Hall Annex, Philadelphia 7, Pa. (June '21)

Oberndorfer, M. W., W. P. Oberndorfer & Son, Box 3174 Customhouse Station, Norfolk 14, Va. (Oct. '43)

Piper, K., Director, Div. of Institutional San., State Dept. of Health, Bismarck, N.D. (Jan. '45) *P*

Sulentic, S. A., Cons. Engr., 337 New England Bldg., Topeka ,Kan. (Apr. '46) *P*

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(Continued from page 36)

Swaim, John P., Salesman, Diamond Alkali Co., 306 W. 2nd St., Wichita 2, Kan. (Apr. '51) *MRP*

Thrasher, W. E., Gen. Supt., Westchester Joint Water Works No. 1, Box 660, Mamaroneck, N.Y. (Jan. '37) *MRPD*

RESIGNATIONS

Eadie, Alfred H., Mgr., Public Utilities Com., Palmerston, Ont. (Apr. '49) *M*

Gerin, Maurice, Mgr., Pump & Elec. Divs., Canadian Fairbanks-Morse Co., Ltd., 980 Saint Antoine St., Montreal, Que. (Jan. '48) *MRP*

Huot, Marcel, Town Engr., 14 Rue de l'Eglise, Ville St. Laurent 9, Que. (Jan. '49) *M*

Jeffs, D. W., Wingham, Ont. (Apr. '44)

CHANGES IN ADDRESS

Changes received between October 5 and November 5, 1952

Barning, Carl Phillip Jr., Chemist, Water Works Dept., 2601 Edgewood St., Evansville 12, Ind. (July '51)

Baum, Richard E., Box 234, R.R. 1, S. State Rd., Arlington Heights, Ill. (Apr. '52) *M*

Beebe, Richard L., 920 Clark St., Rapid City, S.D. (Jr. M. Apr. '52) *MP*

Brannock, Durant York, Supt., Water & Sewage Plants, Burlington, N.C. (Oct. '39) *MP*

Cypert, Roy P., 2206 Barnard Ave., Waco, Tex. (Oct. '51)

Francis, Lee H., c/o Creole Petroleum Corp., Maracaibo, Venezuela (Jan. '51) *MRPD*

Huzelswart, Donald E., Supt., Munic. Water Works, 433 Anglaize St., Defiance, Ohio (July '49)

Herrmann, A. J., Asst. Gen. Sales Mgr., American Cast Iron Pipe Co., Box 2603, Birmingham, Ala. (July '44)

Howe, B. V., Ripple & Howe, 833–35—23rd St., Denver 5, Colo. (Apr. '30) *Fuller Award '40 PD*

Leamington Public Utilities Com., J. N. Timberlake, Mgr., Leamington, Ont. (Corp. M. Apr. '51)

Lindell, O. V., Mgr., Central San. Div., The Dorr Co., 610 Church St., Evanston, Ill. (July '48)

Perez La Salvia, Hugo, Civ. & San. Engr., Apdo. 4316, Caracas, Venezuela (Jan. '46)

Ripple, Oliver J., Ripple & Howe, 833–35—23rd St., Denver 5, Colo. (Jan. '30) *Director '40–'43. Fuller Award '42 RPD*

Roop, William C., 609½ N.C. 14th Ave., Fort Lauderdale, Fla. (Affil. Jan. '51)

Royer, R. Stuart, & Assoc., Edward H. Ruehl, 15 W. Cary St., Richmond 20, Va. (Corp. M. Jan. '48)

Smith, Julian Polk Stuart, Jr., Sales Engr., Neptune Meter Co., 201 Oronoco Ave., Apt. 2, Richmond, Va. (Apr. '52)

Spratt, Eugene C., 201 Bradford Apt., 3301 St. Paul St., Baltimore 18, Md. (Jan. '51) *MRPD*

Taylor, Henry W., Cons. Engr., 80 Atlantic Ave., Lynbrook, N.Y. (Jan. '48)

Timberlake, J. N.; *see* Leamington (Ont.) Public Utilities Com.

Weber, Walter H., Sales Repr., Western Supply Co., 211 N. 9th St, Beatrice, Neb. (July '52)

Wells, Kenneth R., Pres., Kent-Norlantic Ltd., Horner Ave., Toronto 14, Ont. (Apr. '51)

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BACTERIOLOGY

Detection of *Escherichia coli* in Drinking Water. Otto Thomann. Mitt. Gebiete Lemensm. Hyg. (Swiss), **42**:517 ('51). Existing methods were critically reviewed. The advantages of using a ricinoleate-formate bouillon are pointed out, inasmuch as the ricinoleate prevents the growth of all organisms not belonging to the *Escherichia* aerobacteric group whereas the formate promotes the growth of the *coli* aerogenic germs. The presence of *Esch. coli* can be clearly proved by a scumming process, by spreading a droplet of the nutrient upon endo- or eosine methylene blue agar whereby the *Esch. coli* can be identified from the typical growth of their insulated colonies.—*CA*

The Use of Bacteriophage for Bacteriological Estimation of Water. Z. Buczowski & Z. Buczowska. Med. Dośw. i Mikrob. (Pol.), **3**:329 ('51). Samples of water were added to broth cultures of *Esch. coli* and *Shigella dysenteriae,* Type I (Shigae) in amts. of 20 ml, and were incubated at 37 C for 6–7 hr in order to produce a preliminary enrichment of any bacteriophage which might be present. The cultures were then heated at 58 C for 30 min to kill the bacteria and drops were incubated on plates of *Esch. coli* and *Shigella dysenteriae* which were subsequently examd. for the presence of plaques. The strains of bacteria which were used had previously been shown to be susceptible to lysis by filtrates from sewage collected in Gdynia; the water samples were also examd. by standard bacteriological methods. Tests were carried out on 126 samples of well water from the environs of Gdynia and Danzig and 22 samples taken at various points from the water supply of the town of Elblag. Bacteriophage was found in 25 samples of well water, 21 of which also contained *Esch. coli* of fecal origin; phage active against *Esch. coli* was found in 10 samples, and against *Shigella dysenteriae* in 5 samples, and against both organisms in 10 samples. The infrequent detection of *dysenteriae* phage may have been due to the overgrowth of water organisms during the preliminary enrichment. Eleven wells were investigated during a period of drought and again after rain; phage was found in 5 samples, all of which had been taken after the period of rain. Samples from 9 other wells were tested after rainy weather and phage was found in 8 of them. Phage was also found in 5 of the 22 samples taken from the water mains of Elblag. Four of these positive samples also contained *Esch. coli* and the water supply was evidently subject to fecal contamination.—*BH*

The Equivocal Effect of Nitrates on the Presumptive Test of Bacteriologically Nonpotable Waters. Haskell S. Tubiash. Am. J. Pub. Health, **42**:1062 (Sept. 1952). Simulated and authentic nitrate-bearing well waters were prepared at levels ranging from 0–240 ppm nitrate nitrogen. These waters were seeded either with

(*Continued on page 42*)

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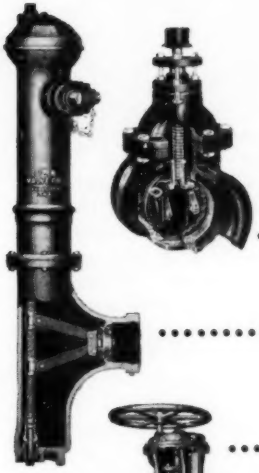

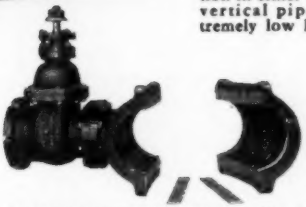

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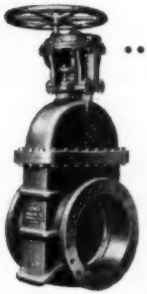

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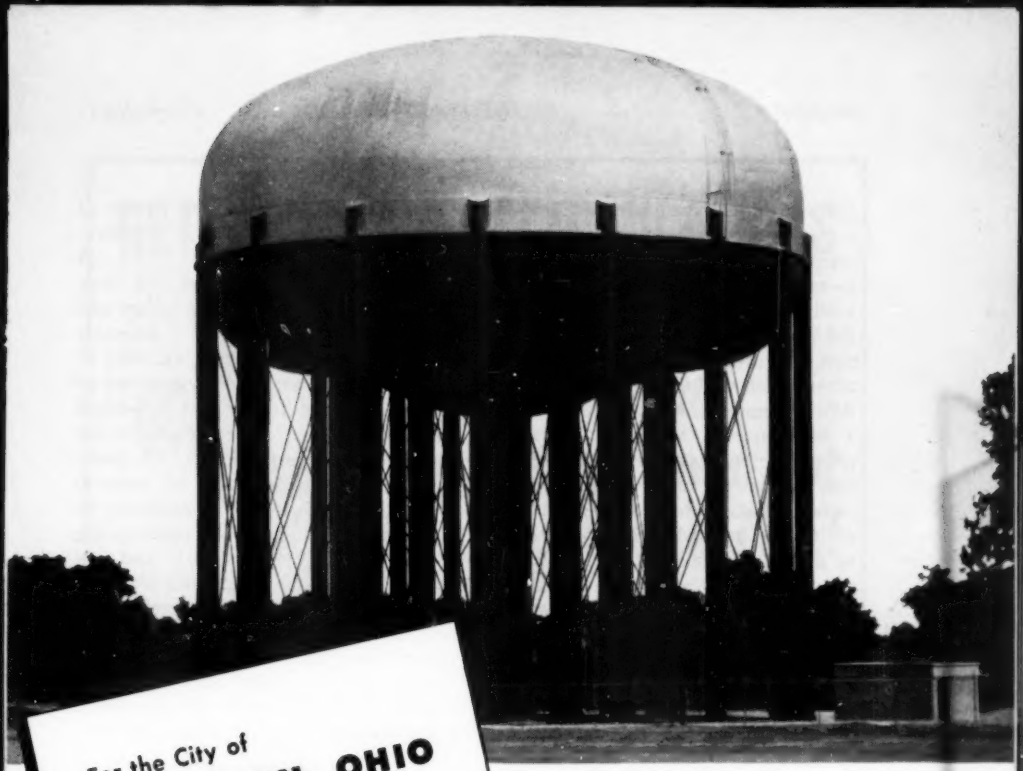
(Continued from page 40)

the equivalent of minimal and relatively heavy pollutions of *Esch. coli, Aer. cloacae, Aer. aerogenes,* and a mixture of the 3 organisms. Presumptive tests for the presence of the *Escherichia-Aerobacter* group were run according to Standard Methods procedures and the MPN per 100 ml detd. Marked ambiguous reductions in MPN were obtained with the heavily seeded waters at levels of 100 ppm nitrate nitrogen and over. Equivocally negative MPN values were obtained with the 18 lightly seeded waters at levels of 100 ppm nitrate nitrogen and over. Although abundant growths were obtained in both heavily and lightly pold. waters at all nitrate nitrogen levels, gas formation by the normally lactose fermenting coliform group of bacteria was frequently completely inhibited. Bacteriologically nonpotable nitrate-bearing waters may erroneously appear to be potable when subjected to the Standard Methods presumptive test because of the inhibitory effect of the nitrates on the production of visible gas by members of the *Escherichia-Aerobacter* group.

The Effect of Overnight Refrigeration on the Results of the Bacteriological Examination of Farm Water Supplies. G. E. Jones, Patricia Franklin, & S. B. Thomas. Proc. Soc. Applied Bact. (Br.), **13**:108 (Oct. '50). Samples of farm water were examd. bacteriologically within 2 hr of sampling, and tests were repeated on the remainder of the sample after it had been kept overnight—that is, for a further period of 18 hr in the refrigerator at 3–5 C. A total of 52 samples were examd., determinations being made of the presumptive *coli-aerogenes* content, presumptive *Esch. coli* content (by direct incubation at 44 C), and the colony counts at 22 and 37 C. Approx. 20% of water samples examd. 20 hr after sampling (18 hr of this period of storage being at 3–5 C) had *coli-aerogenes* and *Esch. coli* contents significantly lower than those detd. by tests on the sample within 2 hr of collection. Significant increases in *coli-aerogenes* and *Esch. coli* contents were much less common—that is, in only 5 out of 43 samples with the *coli-aerogenes* test and 1 out of 37 with the direct 44 C test. In fact, samples with over 50 such organisms per 100 ml at the earlier testing time seldom showed an increased content after refrigeration overnight, and never was an increase in the presumptive *Esch. coli* content on storage associated with an increase in presumptive *coli-aerogenes* content. The colony counts at 37 and 22 C did not show the same marked decreases in numbers after refrigeration as was experienced with the *coli-aerogenes* and *Esch. coli* tests. It is therefore apparent that storage overnight even on ice may cause acceptance of water samples which do not in actual fact fulfil the particular standards advocated, or may lead to a change of verdict on the suitability or otherwise of a particular sample. Storage overnight will lead to reduction on typically fecal *coli-aerogenes* organisms, such as *Esch. coli* Type I, and possibly to multiplication of other members of the group, not typically fecal. —*BH*

Shortening the Time Required for Water Examination by the American Standard Method. G. P. Alivizatos & A. Emmanouelidou. Arch. Hyg. (Gr.), **1**:215 (July–Sept. '50). The application of the American Standard Method of water examn. involved a difficulty in obtaining rapid results because of the length of time required to complete the analysis and the difficulty of isolating coliform bacteria from the large numbers of organisms developing in the medium.

(Continued on page 44)



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(*Continued from page 42*)

Efforts were concentrated on devising a medium which would exhibit the main characteristics of *Esch. coli* Type I—namely, the fermentation of lactose with gas production concurrently with the production of indole and, in addition, to prevent the development of other microorganisms in the water. After a number of preliminary trials a medium was made up containing phenol and crystal violet as the specific inhibitory agents, both of which have previously been incorporated individually in media for the isolation of coliform organisms, but, so far as the reviewer is aware, it is the first time that the two reagents have been used together in the same medium. The medium is made up as follows: proteose-peptone (Difco) 10 g; bactotryptose 20 g; lactose 2 g; K_2HPO_4 3 g; sodium chloride 4 g; crystal violet solution (0.1%) 2 ml; distilled water 1 l; pH prior to adding crystal violet 7.2. Successful tests have so far been obtained with pure strains of coliform organisms and the medium is now being tested concurrently with standard lactose broth and MacConkey broth in connection with water examn., and the results therefrom will be communicated at a later date.—*BH*

A Medium for the Study of the Bacterial Oxidation of Ferrous Iron. W. W. LEATHEN, L. D. MCINTYRE, & S. A. BRALEY. Science, **114**:280 ('51). The authors have devised a synthetic medium suitable for the cultivation of the iron-oxidizing bacteria found in acid mine waters. To 1000 ml of distilled water are added 0.15 g of ammonium sulfate, 0.05 g of potassium chloride, 0.50 g of magnesium sulfate, 0.05 g of dipotassium phosphate, and 0.01 g of calcium nitrate. The mixture is autoclaved and cooled, and 10 ml of a 10% soln. of ferrous sulfate in distilled water are added. The medium is opalescent and has a pH value of approximately 3.5.—*WPA*

New Contribution to the Study of the Iron Bacteria. I. G. V. BENEDEN. Hydrobiologia, **3**:1:1 ('51). A simplified classification of the iron bacteria is given and morphology and physiology are described. Attempts were made to grow pure cultures of the bacteria, using different types of media, but the forms that developed were of reduced size and spores did not produce mature forms. A study of the adventitious form of bacteria showed that they had a tendency to form chains. In impure cultures the bacteria developed rapidly and assumed the typical appearance observed under natural conditions. Experiments were made to det. the cause of suppressed growth in pure cultures and it was concluded that it may be caused by the absence of some biotic substance produced by other bacteria. —*WPA*

Hydrogen Utilization by Some Marine Sulfate-Reducing Bacteria. F. D. SISLER & C. E. ZOBELL. J. Bact., **62**:117 ('51). The authors investigated aspects of the utilization of molecular hydrogen by cultures of *Vibrio desulfuricans* isolated from marine sediments. Of 39 cultures tested, 33 were able to utilize hydrogen in a lactate medium and 11 used hydrogen as the sole source of energy in an inorganic medium. Some of the cultures were able to utilize hydrogen only after cultivation in its presence for several generations, indicating that hydrogenase may be an adaptive enzyme. The ratio of hydrogen consumed to hydrogen sulfide produced was greater in the inorganic medium than the theoretical value for reduction of sulfate and it was found that carbon dioxide was also being reduced. Hydrogen was utilized more readily in the presence of sulfite, thiosulfate, and fumarate than in the presence of sulfate. There was also evidence that the bacteria were capable of nitrogen fixation.—*WPA*

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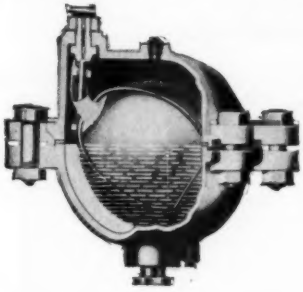

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Page numbers refer to P&R section of Journal. Letters immediately preceding page numbers refer to month of issue, using following key: Ja—January; F—February; Mr—March; Ap—April; My—May; Je—June; Jl—July; Au—August; S—September; Oc—October; N—November; D—December. All subjects and page numbers in boldface type indicate first pages of topic sections or several abstracts on particular subject.

Accounting and Financing, F 44
Aedes aegypti; eradication of, with DDT, Oc 80
Aeration system; for raw water, Ap 70
Africa; water problems of, Au 52
Algae; chemical composition of, F 64
combating tastes and odors due to, Oc 84
effects of, on water supply, F 62
Algae Control, F 60
Aluminum; colorimetric determination of, N 68
microanalysis of, N 70
polarographic determination of, Au 64
Aluminum hydroxide sol; effect of anion on coagulation of, Mr 72
Aluminum sulfate; use of, in hot lime-soda water softening, Oc 42
Ammonia; chloro derivatives; formation of, Mr 48
Animal parasites; review of occurrence and survival of, F 50
Anion; effect of, on coagulation of aluminum hydroxide sol, Mr 72
Annual Reports, Ap 52, My 40, N 42
Aquatic invertebrates; as indicators of stream pollution, Oc 78
Arsenic; determination of, Je 48
ASTM Standards; 1950 supplement to, Je 48
Atomic energy; *see* Radioactive materials, Radioactive wastes
Australia; Brisbane; water supply of, Je 56
Victoria; conservation project in, F 66
water engineering in, Au 54

Bacteria; *see also* specific organism
coliform; relation to gas production, F 50
Bacteria (*contd.*); evolution of, in untreated swimming pool, Jl 38
fish as carriers of, Mr 82
iron; classification, morphology, and physiology of, D 44
sulfate-reducing; characteristics and culture of, F 54
hydrogen sulfide evolution of, F 52
hydrogen utilization of, D 44
role in underground corrosion, Jl 60
use of, in biological warfare, S 62
Bacteriology, F 50, Jl 46, D 40
Bacteriophage; use of, for bacteriological estimation of water, D 40
Biological analysis of water pollution, Mr 80
Biological research; freshwater; relation to water supply, F 60
Blood; fluoride content of, Jl 46
Blue babies; *see* Methemoglobinemia
Bluegill; effect of inorganic salts on, N 40
Boilers; protection of, Jl 54
Boilers and Feedwater, Jl 52, N 72
see also Corrosion
Borings; horizontal; water supply from, Ap 74
Boron; determination of, N 70
Brazil; Sao Paulo; fluorine in water supply of, Oc 64
Brine; *see* Salt water
British Columbia; Burnaby; annual report, Ap 54
Butter wash water; public supplies for, Ap 80

Calcium; colorimetric method for estimation of, Je 48
indirect determination of, Je 50

(*Continued on page 48*)

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MEETS A. W. W. A. SPECIFICATIONS

(*Continued from page 46*)

California; Fish Lake Valley; ground water in, Au 38
ground water in, Au 38
report of water pollution control in, Oc 66
Canada; Saskatoon; water and sewage problems of, Ap 68
Carbon; activated; application of, Oc 82
slurries; taste control with, Oc 82
Carbon dioxide; determination of, N 70
removal of, Au 44
Cathodic protection, Jl 64
of buried metal structures, Jl 62
of steel structures, Jl 58
of underground pipes, Jl 72
use of, at Imperial Dam, N 66
Cation exchange; physicochemical investigation of, Mr 66
zeolite softening system; use of, Oc 48
Cemeteries; as sources of water pollution, Mr 76
Chemical Analysis, F 58, Ap 58, Je 48, Au 64, S 42, N 68
use of, in evaluating water, Jl 52
Chemical Feeding, Conditioning, and Sedimentation, Mr 68
Chemicals; corrosion control with, Jl 66
feeding of, to boilers, Jl 54
shortages; substitutes during, Au 48
Chloramine; disinfection of water on ships with, My 74
photometric measurement of, F 58
Chloride; determination of, Je 50
determination of traces of, Au 66
Chlorination; *see also* Disinfection
equipment; installation and operation of, Oc 52
simple apparatus for, Ap 72
Chlorine; comparison of bactericidal action of ozone and, My 74
free; determination of, N 70
residual; photometric measurement of, F 58
water disinfection by, Oc 52
Chlorine dioxide; as bactericide for water treatment, My 76, My 78
effect of, on taste and odor removal, Oc 82
Classification of ground waters, My 68
Coagulation; activated silica as aid to, Mr 68, Mr 70
hydrolysed ferric salt as agent for, Mr 72
Coalfield; water supplies in, F 42
Coatings; protective; for lead pipe, F 72
formation of, on lead pipes, S 66
Coliform bacteria; *see* Bacteria
Color; electrophotometry; applications of, in water chemistry, S 50
photometric estimation of, Ap 62
Concentration films; role of, in corrosion prevention, N 62
Concrete tanks; prestressed; construction of, F 66
Connecticut; New Britain; ground water supply for, My 64
Conservation project in Victoria, Australia, F 66
Consumption; in Netherlands, F 50
Cooling systems; diesel locomotive; water conditioning for, Ap 80
Cooling water; chromium salts in, Ap 80
Copper; bactericidal action of, Oc 52
determination of, in drinking water, Ap 58
pipe; corrosion of, F 72
Corrosion and Corrosion Control, Jl 58, N 56
see also Boilers and Feedwater
asbestos-cement water mains, S 56
chemical inhibitors of, N 66
copper pipe, F 72
effect of stray currents on, F 74
review of preventive measures for, N 66

Dam Construction and Maintenance, Ja 38
Dams; Swedish earth and rock-fill; description of, Ja 50
Dental caries; relation of fluorides to, Mr 72, Jl 42, Jl 44, Jl 46, Oc 56, Oc 60
Dental mottling; relation of fluorine to, Oc 60
Design of water supplies, aspects of, F 54
Detroit River; pollution control of, Oc 64
Diagrams; illustration of chemical composition of water with, Je 48
Diseases; *see also* Health and Hygiene; Methemoglobinemia; Typhoid
transmission; by water, My 72
Disinfection, F 68, Mr 48, My 72, Oc 48
ion-exchange bodies, Oc 44
Dissolved oxygen; role of, in inhibition of corrosion by sodium phosphate solutions, N 56
Distilled water; preparation of, as boiler feedwater, Jl 54
Distillery wastes; treatment of, Oc 74
Distribution Systems, F 66, S 52
Drainage; Moorland gripping system of, F 44

(*Continued on page 50*)

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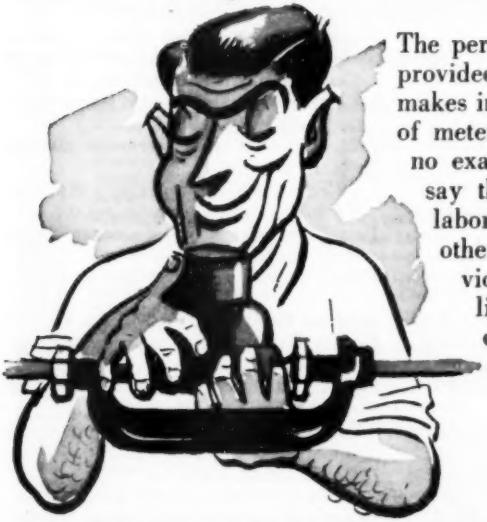

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(*Continued from page 48*)

Economic factors; in waste-water treatment, Mr 78
Electrical currents; effect on corrosion of, F 74
treatment of boiler feedwater with, Jl 52
Electrocolloidal treatment of boiler water, N 74
Endameba histolytica; review of occurrence and survival of, F 50
England; Durham; underground water supplies of, F 42
gravel problem in highland watercourses of, F 42
Haweswater; reservoir at, Ja 44
Huddersfield Corp. Waterworks; reservoir scheme of, Ja 56
industrial water plant in, Au 54
Metropolitan Water Board; annual report, My 40
Sheffield; annual report, N 56
West Hartlepool; prestressed concrete tanks in, F 66
Worcester; extensions to water works of, Mr 64
Enterococci; as index of water pollution, Jl 46
detection of, Jl 48
Escherichia coli; as index of water pollution, Jl 46
culture medium for detection of, Jl 46
detection of, D 40
determination of, Jl 48
Evaporators; survey of, Jl 58

Feedwater; *see also* Boilers and
economics of treatment of, N 72
filtration of, N 74
preparation of, N 74
Ferric salt; hydrolysed; as flocculating agent, Mr 72
Filter sweeps, Je 52
Filters; diatomaceous earth and activated carbon; description of, Je 54
high-rate; use of, in Salina, Kan., Je 54
rapid gravity and pressure; construction and operation of, Je 52
sand; method for washing of, Je 54
Filtration, Mr 60, Je 52
Filtration plant; description of, at Poaka Beck, England, Mr 60
model for problem town, Mr 62
Financing; *see* Accounting and
Fish; as carriers of bacteria, Mr 82
as indicators of stream pollution, Mr 82
toxicology of, Mr 86
Fittings; erosion of, Je 62
Flood discharge; determination of, Ja 38
estimation of, by statistical methods, F 56
Florida; economic aspects of ground water in, My 64
Flow; measurement of, by chemical methods, Ap 66
underground; tracing of, My 68
Fluoridation, Mr 72, Jl 40, Oc 54
public health aspects of, Oc 62
various problems associated with, Mr 76
Fluorides; colorimetric determination of, Je 50, Au 66
comparison of, for water fluoridation, Jl 42, Oc 54
determination of, Au 66
improved micromethod for determination of, Mr 74
metabolism of, Jl 46
naturally occurring; study of distribution of, Jl 42
in water supplies in Danzig, Poland, N 70
photofluorometric titration of, Mr 74
rapid test for, Mr 74
removal of, from water, Jl 46, Au 42
Foreign Water Supplies, F 64, Je 56, Au 52
see also entries under specific countries and areas
France; Alençon; water supply of, Au 54
consequences of 1949 drought in, Au 62
Gerardmer; water supply of, Au 56
Le Hâvre; drinking water supply problems of, Au 58
Luxembourg; purification of streams in, Oc 74
Orléans; potable water supply of, Au 60
Pontoise; water supply of, Au 60
French Guiana; Cayenne; water supply of, Au 62
Frost; thermal protection against, F 68

General Treatment, Ap 70, Au 42
Geophysics; use of, in ground water studies, Au 40
Germ count; determination of, in drinking water, Jl 52
Germany; ground water as reserve supply for, Au 40
Hagen; water supply of, Je 56
Saxony; water treatment at, Au 46
Gravel; in highland watercourse, problem of, F 42
Ground Water, Ap 74
see also Sources of Supply

(*Continued on page 52*)

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(*Continued from page 50*)

Ground Water (*contd.*); formation of, Au 42
indexes of quality of, N 38
iron and manganese in, Oc 42
nitrate in, My 70
removal of iron from, by adsorption, Oc 42
studies on, Mr 58, Je 58
summary of, in U.S., Au 40

Hardness; determination of, Ap 60, Au 66, S 42, N 72
hygienic importance of, S 64
influence of benzylalkonium chloride on, Oc 50
temporary; relation between conductibility and, Ap 60
Hawaii; geology and ground water resources of, My 66
Health and Hygiene, My 69, S 62, Oc 80
see also Fluoridation; Methemoglobinemia
Humidity; atmospheric; recovery of, Mr 60
Hydraulics, Ap 62
Hydrogen peroxide; bactericidal action of, Oc 48
Hydrology, Conservation, and Irrigation, F 54, Mr 58
Hydrosols; study of waters by adsorption on, S 46
Hygiene; *see* Health and

Illinois; Chicago; annual report, N 42
new filter plant for, Mr 64
ground water in, Au 38
Industrial wastes; abatement of stream pollution by, Mr 84
flowmeter equipment for measurement of, Oc 76
fundamentals of control of, Mr 86
minimum requirements for control of, Mr 84
poisoning from, My 72
purification of, Mr 84
stream pollution; problem from, Mr 86
tank-car; treatment of, Mr 78
toxicity of, Mr 80
treatment of; with chlorine, Mr 76
ways to economize on, Mr 86
Industrial Water Supply, Ap 80
Industrial water system; biological damage in, N 38
Ion exchange; application of, Oc 44, N 72
monobed; for water treatment, Mr 68
Ion exchange (*contd.*); studies in, Mr 66
use of, in removing fluorides from water, Au 42
Ionic method; reporting water analyses by, S 52
Iowa; Dubuque; annual report, My 42
Winterset; taste and odor control at, Oc 82
Iran; Teheran; water supply of, F 64
Iron bacteria; *see* Bacteria
Iron; ferrous; medium for bacterial oxidation of, D 44
microanalysis of, N 70
removal of, Mr 64, Au 44, Oc 48
Italy; Ferrara; research on ground water of, Au 40

Lake Erie; pollution survey of, Oc 64
Lead; determination of; in drinking water, Ap 58
Lead pipe; *see* Pipe
Leaks; decrease in, by pressure reduction, S 58
Legal aspects of ground water pollution, My 66
Legislation; state; for water pollution, My 62
Lime; corrosion treatment with, N 58
Louisiana; coastal waters; salinity variations in, N 38
New Orleans; annual report, My 42

Mains; *see* Pipelines
Management; water works; financial considerations of, F 44
Manganese; natural water content of, S 42
removal of, Mr 64
Manitoba; Dauphin; annual report, Ap 54
Maryland; Calvert County; water resources of, Ap 78
Membrane filter; use of, in sanitary bacteriology, Jl 50
Metals; dissolved; scattering of light by, N 66
Metering; economics of, Je 62
Methemoglobinemia; high-nitrate waters as cause of, S 66
survey of, My 68
well water and, My 70
Mexico; water-softening plant in, Oc 42
Michigan, Ann Arbor; annual report, My 40
Detroit; annual report, N 46
Microchemistry; in water analysis, S 50
Microcrustacea; treatment for, Au 44
Microstaining, Ap 72

(*Continued on page 54*)

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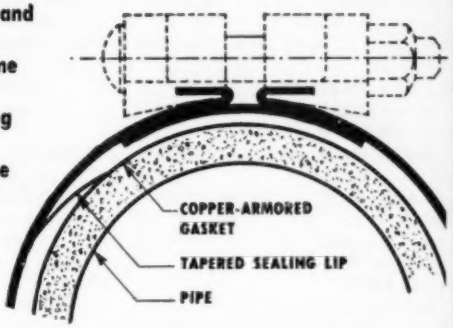

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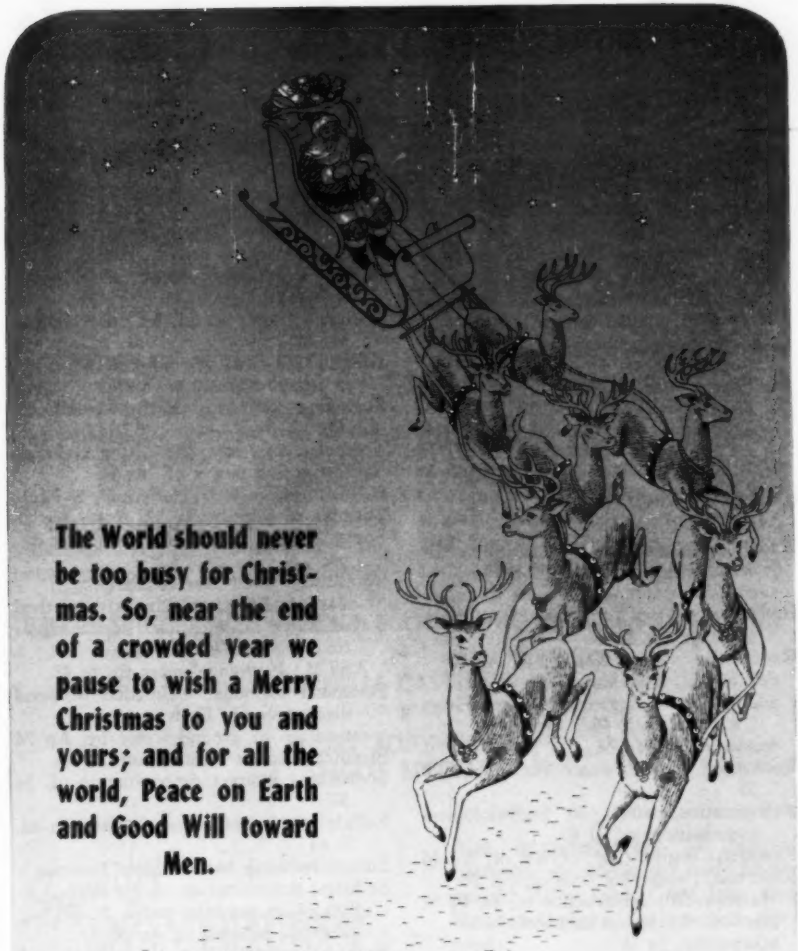
(*Continued from page 52*)

Milk; as vehicle for fluoridation, Jl 40
Molecular filter; *see* Membrane filter
Montana; Helena Valley; ground water in, Au 38
Miles City and Glendive; ground water resources of, Ap 78
Municipal supplies; *see specific states, provinces, and countries*

Nebraska; ground water conditions in, Ap 78
Loup River Basin; chemical quality of surface waters in, Ap 78
Netherlands; butter wash water problem in, Ap 80
Katwijk; displacement test at, Au 40
water consumption and costs for, F 50
Nevada; eastern; hydrology of, Ap 78
Fish Lake Valley; ground water in, Au 38
New Mexico; San Miguel County; geology and ground water resources of, Ap 78
New York; Columbia County; ground water resources of, Ap 78
Elmira; annual report, My 42
Fulton County; ground water resources of, Ap 80
Schoharie County; ground water resources of, Ap 80
Seneca County; ground water resources of, Ap 80
Nitrates; determination of, S 42
effect on nonpotable water of, D 40
Texas ground water, My 70
methemoglobinemia due to, My 68, My 70
Nova Scotia; Halifax; annual report, N 50
Odor; *see* Taste and
Ohio; chemical character of surface waters of, Ap 80
water pollution control in, Oc 64
Ohio River Drainage Basin; pollution control in, My 50
Oil; infrared spectrophotometric determination of, Ap 58
Oklahoma; Muskogee County; ground water resources of, My 66
Oklahoma City; stream pollution in, My 62
Ontario; Brockville; annual report, My 42
Chatham; annual report, Ap 56
fluoridation in, Oc 64
London; annual report, My 42
Organic matter; test for traces of, N 72
Oxygen; biochemical consumption of, influence of nitrification on, S 42
consumption by organic substances of, My 62
determination of, S 42
dissolved; determination of, Ap 58
high content in water, significance of, S 50
Ozone; comparison of bactericidal action of chlorine and, My 74
determination of, N 72
disinfection of water with, My 74, Oc 54

Paint; as protection against corrosion, Jl 58
see also Coatings; Corrosion and Corrosion control
Pennsylvania; Erie; annual report, Ap 52
Pittsburgh; ground water resources in, My 66
Petroleum industry; control of wastes from, Ap 68
Phenol; infrared spectrophotometric determination of, Ap 58
Phosphate powders; deliquescence and solution rate control of, Ap 72
Photometric measurement of chlorine and chloramine, F 58
Pipe; copper; corrosion of, F 72
lead; formation of protective coatings on, N 58
protective coatings for, F 72
use in distribution system of, Je 64
plastic; effect upon water quality of, Je 60
experiences with, Je 62
prestressed concrete; in distribution system, S 52
Pipelines; asbestos-cement; corrosion of, S 56
effect of water and soils on, S 56
disinfection of, F 68
maintenance of, in Saskatoon, S 62
various types, use of, S 60
Plastic pipe; *see* Pipe
Plumbing Code Commission; report of, Ap 76
Poisoning; lead; of drinking water, S 66
Poland; development of water supply and sewage treatment for, Ap 70
industrial water supply problems in, Ap 80
Pollution; bacteriological indexes for, Jl 46

(*Continued on page 56*)



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(*Continued from page 54*)

Pollution (*contd.*); protection of ground water supplies against, My 68
radioactive; survey meter for monitoring waters containing, S 46
river; control of, Mr 80
Pollution Control, Mr 76, Ap 68, My 50, Oc 64
Potassium permanganate; use of, in disinfection of water, Oc 48
Pressure drop; through fixed and fluidized beds, Ap 66
Processing; corrosion problems in, N 66
Puerto Rico; annual report, N 54
Pumping station; England; modernization of, Je 56
Purification; of swimming pool water, Jl 38
waste water; iron removal process for, Oc 42

Quality of Water, N 56

Radio communication; installation; description of, F 66
use of, for water works, S 60
Radioactive materials; detection of trace quantities of, Je 52
Radioactive wastes; disposal of, Ap 70
removal of, from water, Au 46
survey meter for monitoring waters containing, S 46
treatment of, Mr 84
Recharge; ground water resources, Au 38
Refrigeration; effect on bacteriological examinations of, D 42
Research; engineering; review of, Au 46
Reservoirs; emptying time of, Ap 66
Haweswater; construction of, Ja 44
planting of trees on banks of, Ja 58
scheme for, Ja 56
silting of, Ja 52
site investigations and economics of, Ja 44
underground; utilization of, Au 38

Sampling apparatus; pneumatic, Ap 62
Sand filters; *see* Filters
Schistosomiasis; fight against, S 64
Sea water; fresh water from; by freezing techniques, Au 42
on liner "Liberte," Au 48
scale control in distillation of, Jl 56
Services and Meters, F 72, Je 60
Sewerage; *see* Pollution Control; Wastes
Silica; *see also* Boilers and Feedwater; Corrosion and Corrosion Control
activated; as aid to coagulation, Mr 68, Mr 70
colorimetric determination of, S 44
protective coatings of, N 62
removal of, by anion exchange resins, Oc 46
Silicates; amperometric titration of, S 44
Singapore; annual report, Ap 56
Sodium hexametaphosphate; inhibiting effect of, Mr 70
Sodium nitrate; use of, for odor control, Oc 82
Sodium phosphates; molecularly dehydrated; reversion of, Mr 68
Softening and Iron Removal, Mr 64, Oc 42
see also Ion exchange; Cation exchange
Soils; filtering power of, Mr 60
Solids in boiler water; effect of, N 74
Sources of Supply, Ja 52, F 42, Ap 78
South Africa; Johannesburg; annual report, N 52
Spreading; water; *see* Recharge
Standards; American standard method of water examination; shortening of time required for, D 42
ASTM; 1950 supplement to, Je 48
Statistical methods; estimation of flood discharges by, F 56
estimation of ground water by, Ap 74
Sterilization; *see* Disinfection
Strontium; indirect determination of, Je 50
Sulfate ions; conductimetric titration of, S 44
Sulfate-reducing bacteria; *see* Bacteria
Sulfates; determination of, Ap 60
effect of, in drinking water, N 38
volumetric analysis of, Ap 58
Sulfides; method of estimating, S 44
Surface active agents; use of, in cooling-tower water treatment, N 62
Sweden; earth and rock-fill dams in, Ja 50
Swimming Pools, Jl 38
Switzerland; Aaretal; ground water works in, Je 56
control of stream pollution in, Oc 78
Vevey; ground water in, Je 58
water supply protection in, Oc 76

Taste and Odor Control, Oc 82
see also Algae
relation of algae to, F 64

(*Continued on page 58*)

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(*Continued from page 56*)

Temperature; influence of, on corrosion rates, N 66
Tennessee; La Follette; new filter plant for, Mr 64
Texas; chemical composition of surface waters of, Ap 80
Thermal protection against frost, F 68
Tin; polarographic determination of, Au 64
Trees; on reservoir banks; planting of, Ja 58
Turbidity; measurement of, Ap 62
water analysis by assessment of, F 58
Typhoid-paratyphoid; epidemiology of, Oc 80

Ultraviolet radiation; sterilization of water with, My 72
United States; *see entries under specific states*
Urine; fluoride content of, Jl 46

Valve maintenance and repair, S 60
Vienna; ground water supply of, Je 60
Virginia; Richmond; annual report, Ap 52

Wastes; *see also* Industrial Wastes, Pollution
radioactive; disposal of, Ap 70
treatment of, Mr 84
Water hammer; effect of water-air surge tanks on, Ap 62
Water supply; effects of algae on, F 62
Water works; *see* Annual Reports; *also entries under specific states, provinces, or countries*
Wells and Ground Water, Ap 74, My 64, Au 38
Wyoming; ground water resources in, My 66

Zeolite; *see* Cation exchange
Zinc; bactericidal action of, Oc 52
determination of; in drinking water, Ap 58
polarographic determination of, Au 64

Authors of Abstracted Articles

Page numbers refer to P&R section of Journal for 1952. Letters in italics immediately preceding page numbers refer to month of issue, in accordance with following key: Ja—January; F—February; Mr—March; Ap—April; My—May; Je—June; Jl—July; Au—August; S—September; Oc—October; N—November; D—December.

Abegg, R., *N* 40
Adler, P., *Jl* 44
Aitkin, R. W., *F* 58
Albright, Philip N., *Oc* 82
Alivizatos, G. P., *D* 42
Allen, C. H., *Jl* 54
Antoniani, C., *Oc* 80
Aoki, Fumio, *S* 44
Aries, R. S., *My* 62
Arnow, Theodore, *Ap* 80
Ashizawa, Takashi, *N* 70
Ast, David B., *Oc* 62

Babcock, H. M., *Ap* 78
Bach, W. Kenneth, *My* 66
Bafna, S. L., *Mr* 68
Bandaruk, William, *Ap* 58
Banerjea, R., *Oc* 48
Barrett, S. G., *Je* 62
Bartos, F., *Je* 62
Barve, P. M., *Mr* 72
Baylis, John R., *Oc* 82
Beger, H., *N* 38
Bell, W. E., *Oc* 42
Bendel, H. L., *Oc* 42
Beneden, G. V., *Jl* 38, *D* 44
Bengolea, D. J., *Au* 44
Benham, A. D., *F* 56
Bennion, V. R., *Ap* 78
Berdan, J. M., *Ap* 80
Berkowitsch, M. T., *S* 44
Bernier, H., *Oc* 54
Bestiev, R., *Oc* 80
Biaggi, Nelson, *S* 64
Blayney, J. R., *Jl* 42
Bliss, H., *Oc* 42
Boorsma, H., *S* 56
Boucher, P. L., *Ap* 72
Bradford, A. D., *Mr* 80
Braley, S. A., *D* 44
Breijer, H. B. G., *My* 74
Brunner, G., *Mr* 82
Brunot, M., *Au* 60
Bryson, J. L., *Mr* 70

(*Continued on page 60*)

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(Continued from page 58)

Buczowska, Z., *D* 40
Buczowski, Z., *D* 40
Buffle, J. P., *My* 74
Burnett, J., *My* 78
Burns, William, *S* 50
Butler, W. S., *Oc* 48
Butlin, K. R., *F* 52, *Jl* 60

Caldwell, D. H., *Jl* 56
Calise, V. J., *Mr* 78
Campos, M. A. P., *Oc* 64
Carey, W. Gordon, *Mr* 64
Carillo, B., *Au* 44
Carlier, M., *Au* 62
Causey, R. S., *Jl* 58
Cavallaro, L., *Mr* 70
Chamberlain, W. J., *F* 62
Chambers, C. W., *F* 50
Chapman, George H., *Jl* 46
Chebotarev, I. I., *Ap* 74, *S* 52
Chevchenko, M. A., *Mr* 72
Choain, A., *Au* 58
Christenson, C. W., *Ap* 70
Clark, Harold F., *Jl* 50
Clayton, C. L., *F* 42
Cluzan, R., *Je* 50
Clyde, G. D., *Au* 38
Cohen, M., *N* 58
Cohn, C., *S* 46
Collopy, J. P., *N* 66
Conlon, R. B., *Jl* 54
Connor, J. G., *Ap* 78
Cooper, H. H. Jr., *My* 64
Coutris, I. R., *Jl* 52
Cover, G. W., *S* 60
Cox, C. R., *My* 70
Crandall, W. R., *Mr* 74
Cronin, H. F., *Ja* 58
Czensny, R., *Mr* 82

Dahl, A. H., *S* 46
Dangoumau, A., *Je* 50
Dantow, M., *Oc* 60
Debenham, Frank, *Au* 52
de Bois-Lucy, M., *Au* 56
de Brouwer, R., *Jl* 62
Debruyne, H., *Je* 50
de Carvalho, A. Herculano, *N* 70
de Hauss, J. L., *S* 50
Demole, V., *Jl* 44
Dennis, E. W., *Oc* 50
De Ridder, M., *Oc* 60
Descroix, P., *Mr* 60
Doan, Richard L., *My* 68
Dobbin, Ross L., *S* 60
Domke, L. C., *Oc* 82
Dougherty, D. F., *Ap* 78
Drane, C. W., *Jl* 66
Dunlop, Stuart G., *Jl* 50
Durum, W. H., *Ap* 78

Eakin, T. E., *Au* 38
Eakin, T. G., *Ap* 78
Eberhardt, W. H., *Mr* 72
Edwards, G., *Mr* 70
Eguillon, M., *Au* 54
Emmanouelidou, A., *D* 42
Eremenko, V. Ya., *Je* 48
Evans, T. A., *N* 66
Evans, U. R., *N* 66

Falk, L. L., *F* 50
Farina, P. E. L., *S* 44
Farkas, Imre, *Ap* 60
Fast, Edwin, *My* 68
Fields, Paul R., *Je* 52
Fletcher, H. Bowden, *Je* 56
Franklin, Patricia, *D* 42
Fredericks, J. C., *Ap* 78
Freeman, W. D., *N* 66
Frison, M., *Au* 48

Gabovich, R. D., *Au* 66, *Oc* 60
Gardner, D. E., *Jl* 46
Gaufin, Arden R., *Oc* 78
Gebigke, Erich, *Jl* 58
Geldreich, Edwin E., *Jl* 50
George, A., *N* 66
George, William O., *My* 70
Geschwind, Zofia, *N* 70
Geyer, R. A., *N* 38
Gillen, M., *Oc* 74
Glover, J. R., *Au* 64
Godwin, F. E., *N* 74
Gomez, Hector Abad, *Oc* 80
Gordon, F. C., *Mr* 64
Gordon, W., *Oc* 82
Gortt-de-Grott, A., *Oc* 52
Grant, G. A., *N* 70
Green, J., *Mr* 68
Griffin, A. E., *Mr* 76
Griggs, R. L., *Ap* 78
Gutzeit, G., *Mr* 78

Hagedorn, Lester T., *Je* 54
Hagrup, J., *Ja* 50
Hahn, F. L., *Au* 66
Hahn, Otto, *Ap* 80
Hallopeau, M. J., *Oc* 52
Hands, G. E., *Mr* 64
Hansom, M. A., *Ap* 80

(Continued on page 62)

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(*Continued from page 60*)

HANSON, ROSS, *Au* 38
HASEGAWA, ICHIRO, *Ap* 58
HASTINGS, WARREN W., *My* 70
HAVER, G. E., *Au* 44
HAW, CLIFFORD, *S* 62
HEADINGTON, C. C., *Ap* 58
HEBAUT, G., *Au* 60
HEDGEPETH, L. L., *Mr* 84
HEINECKE, GEORG, *Oc* 48
HEINSEN, ERICH, *Au* 46
HENDRICKSON, G. E., *Ap* 78
HEYMANN, E., *Mr* 66
HICKETHIER, CARLOS F., *N* 62
HIEBENTHAL, FRITZ, *Au* 46
HILDEBRAND, J. C., *Mr* 72
HILL, I. N., *Jl* 42
HILL, MURDOCH, *N* 74
HILLEBOE, HERMAN E., *Oc* 62
HOBDAY, S. R., *Mr* 84
HODGE, H. C., *Jl* 46
HODGSON, H. W., *Au* 64
HOGL, O., *Ap* 58
HOLINGER, F., *Oc* 78
HOLZL, H., *S* 64
HOPKINS, EDWARD S., *Je* 52
HOPKINS, W., *F* 42
HORBERG, L., *Au* 38
HORTON, C. A., *Mr* 74
HOSKIN, D. G., *Ap* 68
HOULIHAN, J. E., *S* 42, *S* 44
HUDSON, HERBERT E. JR., *Je* 54
HUET, M., *Mr* 80, *Mr* 86
HURLEY, T. F., *Jl* 52
HURSH, J. B., *S* 46
HZN, R. WIND, *Au* 40

INDELLI, A., *Mr* 70
INGLESON, H., *Jl* 52
INGOLS, R. S., *Mr* 72, *My* 76
INVERNIZZI, IDA, *Je* 50
IPACH, E., *S* 42
IRELAN, BURDGE, *Ap* 80
ISIDORO, RENATO, *S* 42
ISON, H. C. K., *N* 66

JAAG, OTTO, *Oc* 76
JAMBOTKAR, A. K., *Mr* 72
JEDERMAN, E., *Oc* 42
JELINEK, O. E., *Jl* 42
JETER, HAROLD L., *Jl* 50
JONES, G. E., *D* 42
JURKIEWICZ, JANINA, *N* 70
JUST, J., *Oc* 48, *N* 70

KABLER, PAUL W., *Jl* 50
KAY, L. A., *Oc* 56
KELLY, S. F., *Au* 40
KEMMER, F. N., *Au* 48
KNIGHT, A. G., *Ap* 62
KNORR, MAXIMILIAN, *My* 68
KNOWLES, G., *F* 64
KOGANOVSKI, A. M., *Mr* 72
KOHL, HANS, *Je* 56
KOLTHOFF, I. M., *Au* 66
KONONOV, V. N., *N* 38
KOVISKI, L. A., *Mr* 72
KRISHNASWAMY, N., *Au* 42
KURODA, P. K., *Au* 66

LABALADE, M., *Je* 50
LACROIX, S., *Je* 50
LAMAR, W. L., *Ap* 80
LAMOUREUX, V. B., *S* 62
LANGELIER, W. F., *Jl* 56
LARSON, T. E., *Au* 38
LATTANZI, WILLIAM E., *Jl* 46
LAUN, RUDOLF H., *Ap* 62
LAVAL, MARCEL, *Je* 54
LAWRENCE, W. B., *Jl* 56
LEATHEN, W. W., *D* 44
LEVA, M., *Ap* 66
LEWIS, W. K., *F* 54
LIEBFELD, JOZEF, *Ap* 70
LINDENBERGH, P. C., *Ap* 70, *Au* 40
LOELTZ, O. J., *Ap* 78
LORENZ, HOWARD W., *Au* 38
LUSS, RUDOLPH, *Ap* 66

MACDONALD, FRANK P., *Jl* 58
MACKENZIE, E. F. W., *Je* 60
MACKERETH, F. J. H., *Je* 48
MACKRILL, H. A., *Mr* 64
MAIER, F. J., *Jl* 40
MAKSIMOVICH, G. A., *My* 68
MALCHOW-MOLLER, O., *S* 42
MARKS, HENRY C., *Oc* 44
MAUCHA, REZSO, *Ap* 58
MAWSON, J. H., *Mr* 64
MAXEY, G. B., *Ap* 78
MCCLURE, F. J., *Mr* 72
MCCOY, JAMES W., *N* 72
MCDILL, B. M., *Oc* 64
MCEWEN, K. L., *N* 70
MCGUINNESS, C. L., *Au* 40
MCINTYRE, L. D., *D* 44
MCKEE, J. E., *Jl* 40
MCRAE, A. D., *Ap* 68
MEDALIA, A. I., *N* 72
MERCER, D., *F* 58
MESTAYER, H., *Ap* 58
METZLER, D. F., *S* 66
MITCHELL, P. B., *Ja* 44

(*Continued on page 64*)

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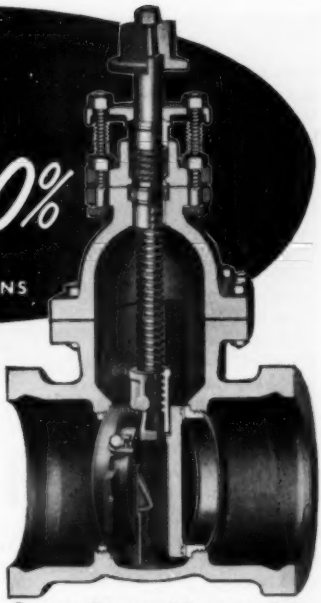

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(*Continued from page 62*)

Mohler, H., *Oc* 42
Moiseev, S. V., *Au* 42
Montgomery, W., *N* 66
Monzini, A., *Oc* 80
Mood, Eric W., *Jl* 46
Mooser, H., *My* 72
Morgante, S., *Au* 40
Morrison, J. L., *Mr* 62
Mosic, A., *Oc* 42
Mozola, A. J., *Ap* 80
Muller, Johannes, *F* 72, *S* 66
Muller, V., *N* 58
Mundy, M. L., *S* 50
Munroe, H. F., *Mr* 76
Munter, Casimir J., *Ap* 72
Myers, David M., *N* 72

Neal, A. W., *F* 68
Newberg, G., *Oc* 76
Newell, John F., *Ap* 70
Norris, Thomas H., *N* 74

Obushowski, I., *N* 70
O'Donnell, I. J., *Mr* 66
Ooykaas, G. A. P., *S* 52
Othmer, D. F., *My* 62
Ovchinnikov, A. M., *Au* 42
Overbeck, R. M., *Ap* 78
Oxford, W. F. Jr., *N* 62

Palin, A. T., *Mr* 48
Papp, Szilard, *Ap* 60
Pater, Janos, *Je* 48
Pearsall, W. H., *F* 60
Peterson, N. L., *N* 38
Piotrowski, Ignacy, *Ap* 62, *Ap* 74
Piper, F. V. H., *My* 78
Pira, G., *Ja* 50
Poland, J. F., *Au* 38
Pope, C. H., *Mr* 58
Portner, C., *Ap* 60
Powell, Sheppard T., *Jl* 54
Pryor, M. J., *N* 58
Pyle, Gray L., *Je* 52

Quevedo, E. A., *S* 44

Radema, H., *Ap* 80
Ragotzkie, R. A., *F* 50
Ramakrishnan, T., *Au* 42
Rao, D. Narayana, *Au* 66
Reed, Edwin W., *My* 66
Reignier, M., *Mr* 84
Renard, M., *Oc* 74
Renner, G. Lyall, *N* 58
Rickson, J. B., *Mr* 74
Rittermann, V., *Oc* 60
Ritzmann, R., *Je* 58
Rivers, H. M., *N* 62
Rivett, W. H. E., *F* 44
Robertson, H. E., *Oc* 54
Robinson, T. W., *Ap* 78
Rohlich, G. A., *F* 64
Rolfe, A. C., *N* 68
Rose, H. E., *F* 58
Rudolfs, W., *F* 50
Runyan, E. J., *Mr* 64
Russell, A. L., *Mr* 72, *Jl* 44
Russell, F. R., *N* 68

Salas, C., *Au* 44
Sampietro, Carlo, *Je* 50
Samuel, Edward, *Au* 54
Samuel, Thomas L. A., *S* 50
Sarkany, I., *Jl* 44
Sarles, W. B., *F* 64
Sarlo, Karoly, *Ap* 60
Savage, W., *Mr* 80
Savinovski, D. A., *N* 72
Schmassmann, H., *My* 74
Schmidt, Janina, *Jl* 48
Schoff, Stuart L., *My* 66
Schroeder, G., *Au* 40
Schroeder, M. E., *Ap* 80
Schudlich, *N* 74
Selke, W. A., *Oc* 44
Seyb, Erich, *N* 74
Shah, H. A., *Mr* 68
Shaw, E. H., *Mr* 72
Sijderius, R., *N* 72
Simard, R. G., *Ap* 58
Simons, R. E., *Oc* 84
Simpson, R. W., *Mr* 86
Sisler, F. D., *D* 44
Smith, A. A., *S* 60
Smith, F. A., *Jl* 46
Smith, J. G., *Oc* 52
Smith, O. J., *Oc* 82
Sobota, Alfred, *Ap* 72
Sokolov, V. F., *My* 72
Southgate, B. A., *Mr* 84
Sparkes, W. J., *Jl* 52
Spaulding, C. H., *Jl* 56
Spencer, K. A., *Jl* 64
Spopintsev, B. A., *My* 62
Stassart, M., *Oc* 46
Steel, E. W., *Mr* 86
Steinbach, A., *Au* 42
Steinwender, A., *Je* 60
Stoltenberg, H. A., *S* 66

(*Continued on page 66*)

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(Continued from page 64)

STONE, R. W., *Mr* 80
STRAUB, CONRAD P., *Au* 46
STRAUB, J., *Jl* 44
STRINGFIELD, V. T., *My* 64
STUNDL, KARL, *S* 50
STYUNKEL, T. B., *N* 72
SULSER, H., *Ap* 58
SUTER, M., *Au* 38
SVORE, J. H., *Oc* 60
SWENSON, FRANK A., *My* 66, *Au* 38
SWENSON, H. A., *Ap* 78, *My* 66, *Au* 38
SYMON, K., *Jl* 46
SZEVERENYI, E., *Jl* 44
SZIGLIGETI, GYULA, *S* 56

TANAKA, MOTOHARU, *S* 42
TARZWELL, CLARENCE M., *Oc* 78
TAYLOR, A. W., *Mr* 70
TAYLOR, E. WINDLE, *F* 68
TAYLOR, G. E., *Ja* 44
TEUTSCH, A., *Je* 56
THOMANN, OTTO, *Jl* 52, *D* 40
THOMAS, S. B., *D* 42
TOMIC, D., *Oc* 60
TORREY, A. E., *Ap* 78
TOTH, K., *Jl* 44
TRASK, C. R., *My* 72
TREAT, G. B., *My* 62
TUBIASH, HASKELL S., *D* 40
TWELFTREE, C. C., *F* 66

UDOVIC-ERAK, R., *Oc* 60

VANDERBORCHT, L., *Jl* 72
VAN DER WAL, S. S., *Oc* 42
VAN HAAREN, F. W. J., *Mr* 76
VAN TUYL, D. W., *My* 66
VENKATARAMANAN, K., *Au* 42
VENKATESWARLU, P., *Au* 66
VERNON, W. H. J., *Jl* 60
VISHER, F. N., *Ap* 78

WALKER, J. G., *Mr* 68
WALTON, G., *My* 68
WANG, WENLAN LOU, *Jl* 50
WARING, F. H., *Oc* 64
WEBER, F., *Mr* 80
WEILER, A., *F* 74
WEINTRAUB, M., *Ap* 66
WEISS, M. D., *My* 62
WENTWORTH, CHESTER K., *My* 66
WESTERBERG, G., *Ja* 50
WESTON, L., *F* 44
WHEATON, H. J., *Mr* 68
WHISKIN, L. C., *F* 68, *Jl* 60
WHITE, E. G., *Jl* 38
WHITLOCK, F. A., *Oc* 56
WICKERT, K., *S* 42
WILKINSON, N. T., *N* 68
WILKINSON, R., *Jl* 52
WILLARD, H. H., *Mr* 74
WILLIAMS, E. E., *Jl* 38
WILLIAMS, E. R., *Jl* 38
WILLIAMSON, A. E., *Oc* 60
WINKLER, G., *Ap* 66
WINTER, EMIL, *Ap* 80
WINTER, R. S. R., *Au* 54
WIPE, M. H., *Ap* 66
WOODS, GEORGE W., *My* 64
WORMWELL, F., *N* 66
WRIGHT, S. L., *Mr* 86
WÜSTENBERG, J., *My* 72

YAKIMETS, E. M., *N* 72
YOUNGQUIST, C. V., *Oc* 64

ZEHENDER, F., *N* 72
ZIPKIN, I., *Mr* 72
ZOBELL, C. E., *D* 44
ZIZZO, S., *S* 46

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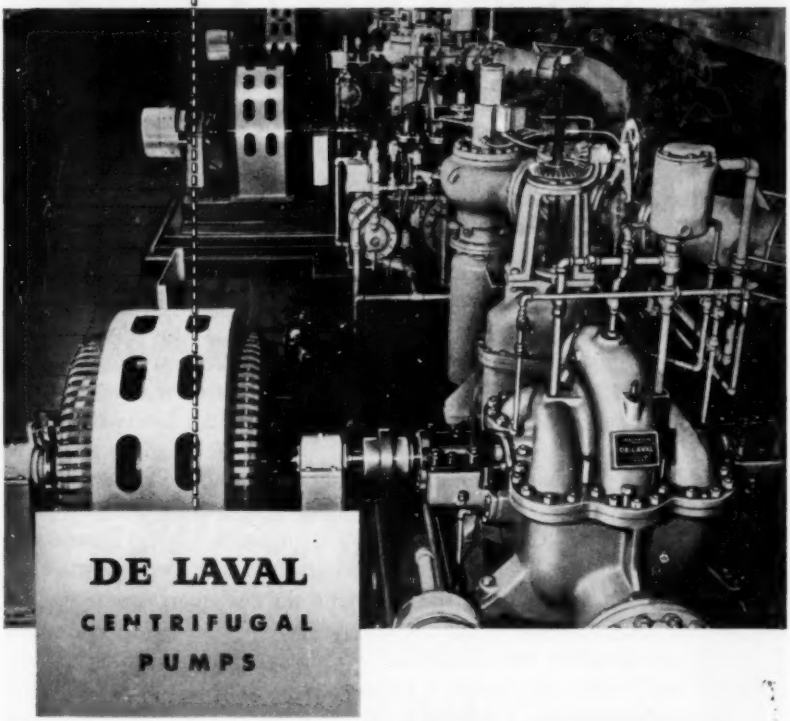
A new threesome for Cambridge



These three motor-driven De Laval centrifugal pumps were recently installed in the Fresh Pond water works of Cambridge, Mass. With an individual capacity of 12 mgd, 175 ft. total head and an efficiency of 88%, this trio will help bring many more millions of gallons of water to the homes and industry of this expanding New England community.

Since the turn of the century, De Laval water works pumps have been serving big cities and small towns throughout the country. These highly efficient De Laval centrifugal pumps are available in capacities ranging from less than 1 mgd to more than 100 mgd.

DE LAVAL *Centrifugal Pumps*

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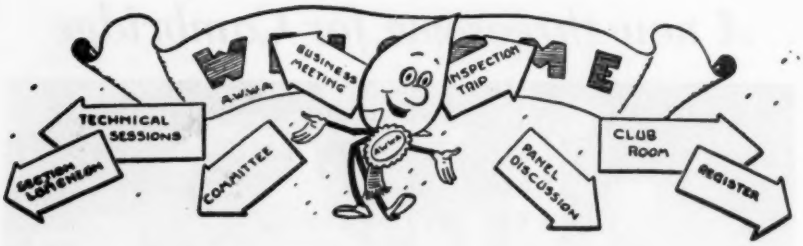


Section Meeting Reports

Michigan Section: The fourteenth annual meeting of the Michigan Section was held in the "Food City"—Battle Creek, at the Post Tavern Hotel on September 24–26, 1952. This interesting location plus a varied program attracted a record attendance of 240 men and 66 women.

After the meeting was called to order by Chairman Louis E. Ayres, new developments in the field were related by John E. Vogt of the State Dept. of Health. Plans to eliminate water shortages and the rapid adoption of fluoridation were among the important developments of the past year.

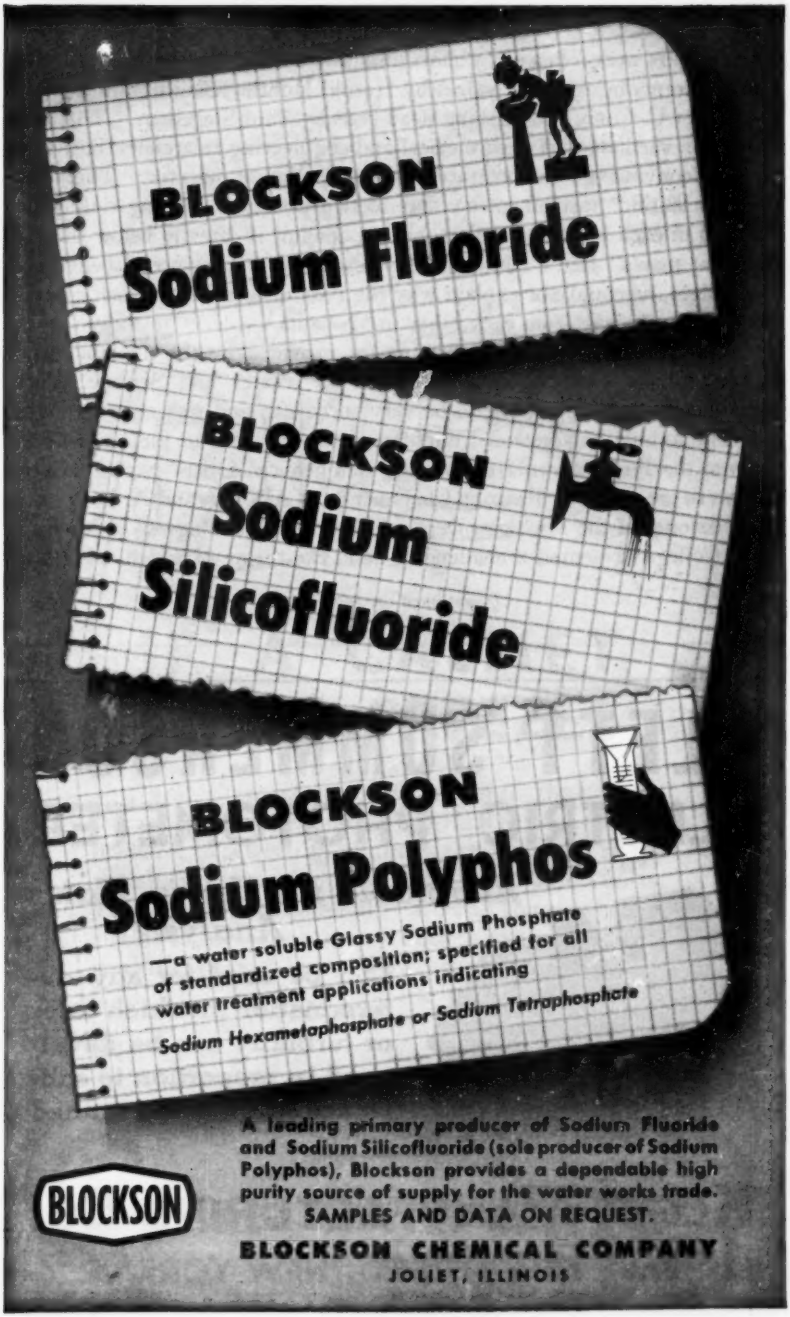
A paper on the "Control of Water Treatment in Piping Systems of Buildings" by Andrew T. Dempster of the Detroit Health Dept. pointed out the importance of safeguarding the supply on the customers' premises. A round table discussion on "Public Relations" was introduced by Raymond J. Faust and included Ivan Fosheim of Pontiac, Robert Hansen of Mt. Clemens, and Robert Strumpfer of Kalamazoo.

A paper by Douglas Feben of the Detroit Water Dept., reviewing the "Michigan Section Education Program," revealed the vastness of this work and the objectives for the future. A symposium on "Tailoring Water for Commercial Customers" included discussions of quantity and quality requirements of paper mills by Charles Waddle, food processing by H. L. Senseman, the canning industry by A. D. Truman, manufacturing by Francis Kallin, and the bottled beverage industry by W. M. Mingee.

After the "Master Plan of Improvements for the Battle Creek Water Supply" was unfolded by Tom Henry, of Jones, Henry & Williams, and the completed improvements of the system were described by Bob McIntosh, director of public works of Battle Creek, a very interesting inspection trip was made of the city's water system and facilities.

The theme of the last morning was "Close the Barn Door." Following this, a paper on "Preventive Maintenance" was presented by Kenneth E. Garvey, superintendent of water for Battle Creek, and one on "Perpetual Inventories" was given by Maurice C. Stout of the Indianapolis Water Co.

(*Continued on page 70*)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SAMPLES AND DATA ON REQUEST.
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(*Continued from page 68*)

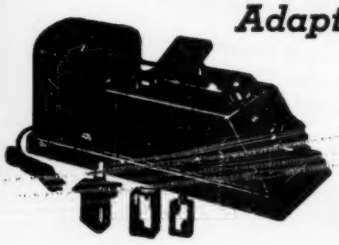
These papers were followed by short discussions on meters by Howard Hartung, hydrants by Al Sabo, valves by Harold Huntley, disinfection of mains by Chester C. Conn, and flushing dead ends by Paul Stegeman. The latter discussion vacillated between medical and engineering references, but ended up in a "convincing" demonstration of a new conduit detector. This ultrasonic "scientific" instrument consists of two L-shaped welding rods which are held in each hand and deflect when a conduit is directly below the "instrument man's" feet. Although Ray Faust is a "convinced" believer in this gadget, he could not explain why the rods deflect toward each other in Michigan and away from each other in Missouri.

The clubroom type of entertainment provided by the manufacturer's representatives with the cooperation of the Water and Sewage Works Manufacturers Assn. proved to be very successful and was enjoyed by all.

The annual banquet on Thursday night was held in the main dining room of the Post Tavern Hotel among rich gems of artists' works. Greetings were presented by Raymond J. Faust from AWWA and A. E. Heustis, commissioner of the Michigan Dept. of Health. Paul Bagwell of Michigan State College presented a challenging talk, the theme of which was "Hats

(*Continued on page 72*)

KLETT SUMMERSON
ELECTRIC PHOTOMETER



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CALMET WATER METERS

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(*Continued from page 70*)

off to the past—coats off to the future." The Edward Dunbar Rich Service Award was presented to 83 persons for completing 25 years of meritorious and faithful service in providing and maintaining a safe and adequate water supply in Michigan. John F. Dye was nominated to be the recipient of the George Warren Fuller Memorial Award. Life Memberships were presented to Louis E. Ayres, William Christian Hood, Lawrence G. Lenhardt, and William M. Wallace.

A very interesting ladies program kept the ladies entertained during their stay and will leave many happy memories of the "food city." Besides enjoying luncheons and programs, a very interesting tour of one of the breakfast food industries was made.

Considerable discussion centered around the arrangements for the national conference to be held in Grand Rapids in May of 1953. The excellent facilities of this convention city were described to the group. The Michigan Section is looking forward to being host to the national meeting and is putting forth every effort to make it one of the best.

T. L. VANDER VELDE
Secretary-Treasurer

Iowa Section: The annual meeting of the Iowa Section was held at the Hotel Hanford in Mason City on October 23–25. The meetings were well attended, the program was interesting, and everyone had a good time.

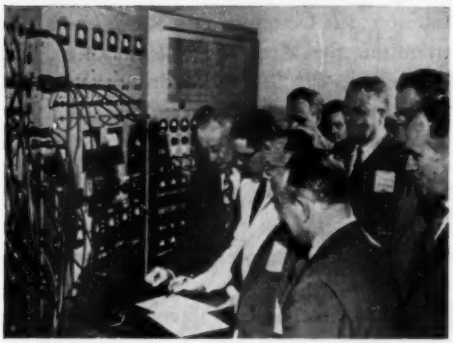
Thursday morning the registrants had a choice of two inspection trips. One group toured the Northwestern Portland Cement Mills, while the second group toured the water works properties. After a pleasant two-hour trip, the first session was called to order by Chairman M. K. Tenny of Des Moines to listen to an address of welcome by Mayor H. E. Bruce of Mason City, and to hear the report of the nominating committee.

The afternoon session opened with a panel discussion on the subject of fluoridation, with Leo Louis, Dale Maffitt, Paul Houser, T. G. Sliter, and R. O. Ellis taking part. The panel reviewed the history of fluoridation and brought the subject up to date. Then Frank McDonald of Electro Rust-Proofing Corp., Earl Bagenstos of Water Tower Paint & Repair Co., and Frank L. Maine of Pittsburgh-Des Moines Steel Co. talked about the protection, maintenance, and design of elevated steel tanks. The afternoon session was concluded by a talk by C. M. Updegraff of the Univ. of Iowa on the subject of the need for a state utility commission. His talk was convincing and cleared up many controversial points.

Everyone enjoyed himself at the Smoker on Thursday evening. An excellent buffet supper was served and the entertainment was delightful. The Iowa Section is rapidly becoming known for its original way of conducting a smoker.

(*Continued on page 74*)

McILROY PIPELINE-NETWORK ANALYZER SAVES DAYS of CALCULATION



During their visit to the American Water Works Association Convention in Kansas City last April, this group of prominent hydraulic engineers and waterworks officials inspect the McIlroy Pipeline-Network Analyzer made by STANDARD ELECTRIC TIME COMPANY for the Midwest Research Institute.

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The McIlroy Pipeline-Network Analyzer performs rapid calculations of flow rates and head losses caused by fluid friction in networks of pipelines or ducts.

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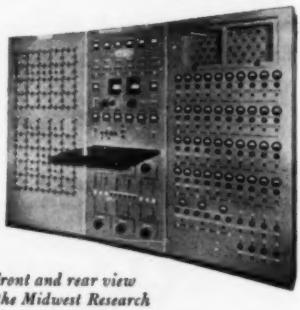
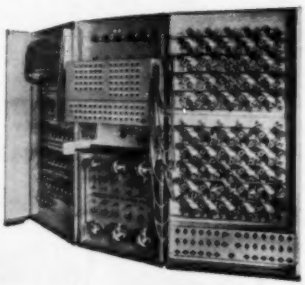
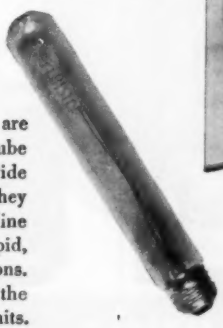
Made for specific applications, the Analyzer is available for any size industrial or municipal network system; the cost varies with the design, size and other requirements. One user saved twice the cost of the Analyzer on a single study of a proposed pipeline improvement problem!



Front and rear view of the Midwest Research Institute Analyzer.





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(Continued from page 72)

On Friday morning the meeting opened with a business session, and the chairmen of the Auditing Committee, the Committee on Resolutions, the Section-Sponsored Activities Committee, the Membership Committee, and the Legislative Committee filed written reports. An election was held and Clifford Hamblin of Mason City was elected chairman, Warner Lang first vice-chairman, Leo Louis, second vice-chairman, and H. V. Pedersen, secretary-treasurer. Invitations for the 1953 meeting place were extended by Council Bluffs and Waterloo.

Following the business session, R. L. Morris, principal water analyst of the State Hygienic Laboratory, gave a most interesting talk on membrane filters.

During the noon hour a group of superintendents attended a luncheon which proved so successful that it was decided to make it an annual affair.

Friday afternoon C. K. Mathews of the Burns & McDonnell Eng. Co. talked about water rates and revenues, a subject which is on every superintendent's mind these days. Then, for a change in pace, F. M. Dawson held the audience spellbound with interesting observations about his recent visit to Pakistan. The Friday afternoon session closed with P. F. Morgan's

(Continued on page 76)

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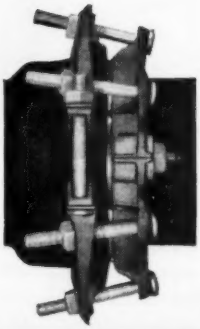

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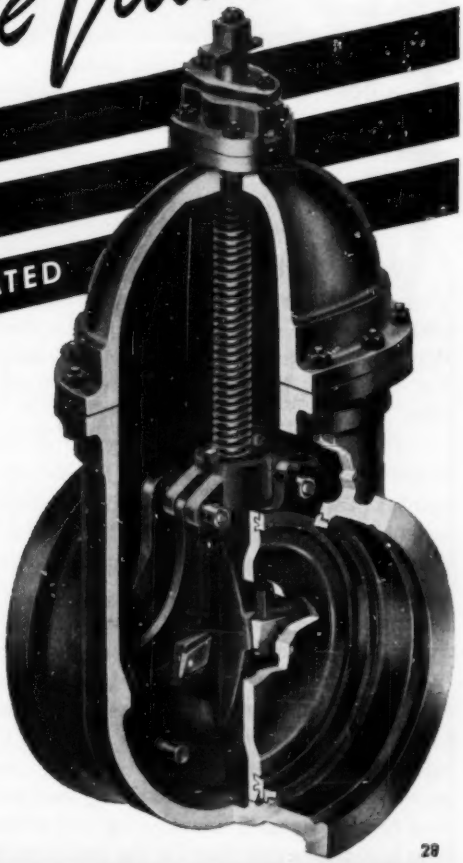

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(*Continued from page 74*)

question and answer box, and for an hour many topics—serious and otherwise—were discussed.

The banquet on Friday evening was the highlight of the convention. Following a sumptuous repast and good entertainment, the chairman of the George Fuller Award Committee announced that John Robertson Barnes had been chosen as recipient of the 1952 award. M. B. Cunningham, vice-president of the American Water Works Association, as guest speaker, commended the Iowa Section for its work and told about the work and the hopes of the Association.

Unfortunately, the Saturday morning session had too great competition in the Iowa-Ohio homecoming game, so it was cut short. But everyone agreed that the 1952 annual meeting of the Iowa Section was better than ever, and that the genial host, Clifford Hamblin, should be given all the credit.

H. V. PEDERSEN
Secretary-Treasurer

West Virginia Section: The fourteenth annual meeting of the West Virginia Section was held in Parkersburg on October 2–3, 1952, with headquarters at the Chancellor Hotel. The West Virginia Sewage & Industrial Wastes Association held its annual meeting at the same place on October 3–4, 1952, and both groups combined for portions of the program on October 3.

The combined registration was 164, with 130 registered for the water works meeting. These totals do not include wives and lay visitors, a goodly number of whom attended for items of special interest. Meeting attendance was below the average for the past several years, although pronounced interest in the program was maintained by those who attended.

The first technical session convened the morning of October 2 with Chairman M. W. B. Stewart presiding. The General Electric film, "Pipeline to the Clouds" was shown before the formal opening of the session to permit the crowd to assemble. After the film, Chairman Stewart introduced Cecil Coffield, Parkersburg water commissioner, who substituted for Mayor Glenn Alleman in welcoming the group. The first address, despite the formidable title, "Water Control Through Statistical Control," proved to be an excellent and thought-provoking discussion and demonstration of statistical techniques used in analyzing control data. The speaker, E. C. Mayo, who is control supervisor for the American Viscose Corp. works at Parkersburg, gave a very lucid lecture.

The extended discussion following the presentation of the paper, "Fluoridation of Public Water Supplies" by Frank E. Law, regional dental consultant, of the Public Health Service, illustrates the active interest in the

(*Continued on page 78*)

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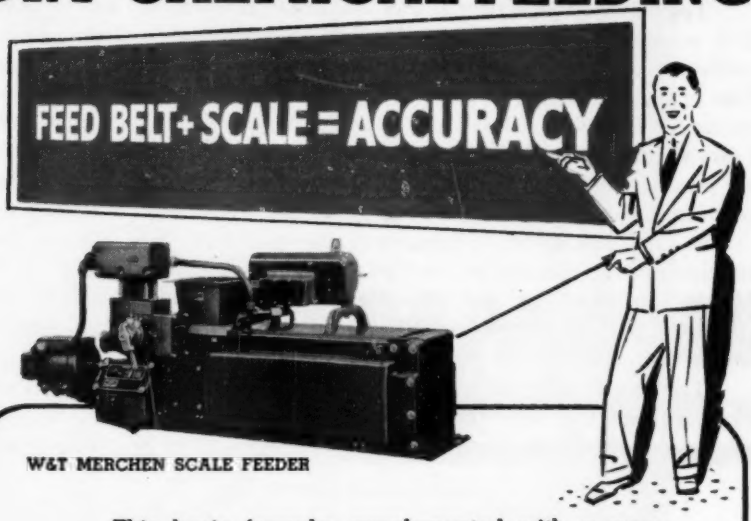

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M-16

(Continued from page 76)

subject. Dr. Law's discussion was largely in rebuttal of the objections which have been put forth against water fluoridation.

The public water system at Pax was installed a year ago and all of the 2-in. or smaller pipe was of flexible polyethelene plastic. Dennis Leary, consulting engineer from Beckley, described the "Performance of Plastic Pipe in the Pax Water System." The pipe has given satisfactory service except for a number of leaks which have developed in the 2-in. pipe. Mr. Leary suggested the need of better control during manufacture and a working pressure equal to 40 per cent of bursting pressure instead of the 60 per cent factor recommended by the manufacturers.

In a nostalgic mood, William Staub, vice-president, West Virginia Water Service Co., Charleston, recalled "Memories of Early Water Works Meetings in West Virginia." Some group pictures dating back to the late 20's were posted at the registration desk and attracted a lot of interest among the old timers.

The second technical session opened with a showing of the Rockwell Manufacturing Co. film "Made to Measure." This was followed by a discussion and demonstration of "The Membrane Filter in Water Bacteriol-

(Continued on page 80)

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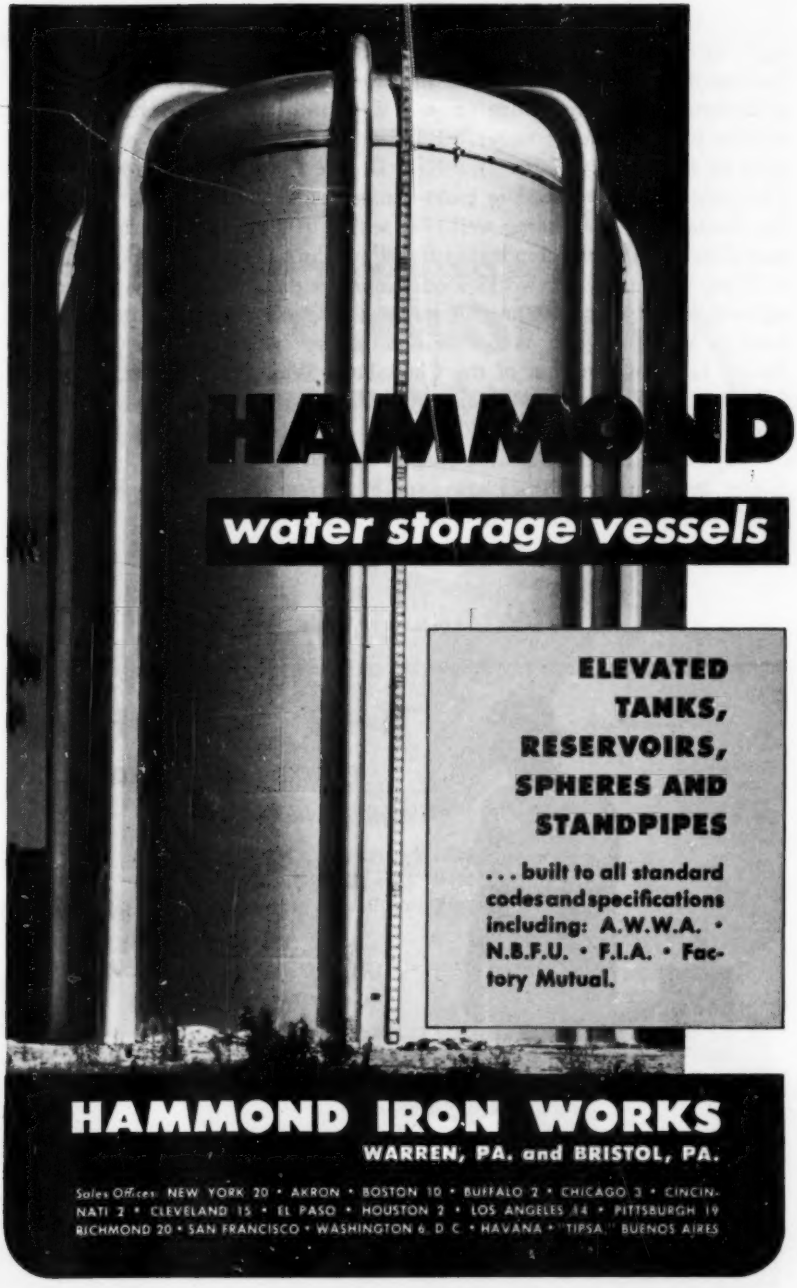
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(*Continued from page 78*)

ogy" by Guido Iannarelli, principal bacteriologist of the State Hygienic Laboratory. Mr. Iannarelli described the testing program now under way to determine the comparative value of the membrane filter technique in the routine examination of water. Ed Shroyer, superintendent of filtration, gave an account of "Fairmont's New Double-Deck Sedimentation Basin." The coagulation and settling basin—constructed in two stories because of site limitations—is working well even with a 100 per cent overload. William Kirchman, superintendent of filtration, Pure Water Co., Logan, mailed to West Virginia water works a questionnaire on corrosion several months ago which enabled him to present an interesting account of "Corrosion Problems in West Virginia Water Works." The second session closed with Henry Gay's description of the Clarksburg Water Board's experience in "Combatting Extreme Pollution at the Clarksburg Water Plant Following West Virginia's Largest Fire."

The third technical session opened on October 3 with a paper by H. K. Gidley describing the "Installation and Performance of Horizontal Collector Wells in Ohio River Gravels." Donald Deakin of the Atlas Mineral Products Co. gave an illustrated lecture on "Jointing Materials for Water Pipe."

(*Continued on page 82*)

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(Continued from page 80)

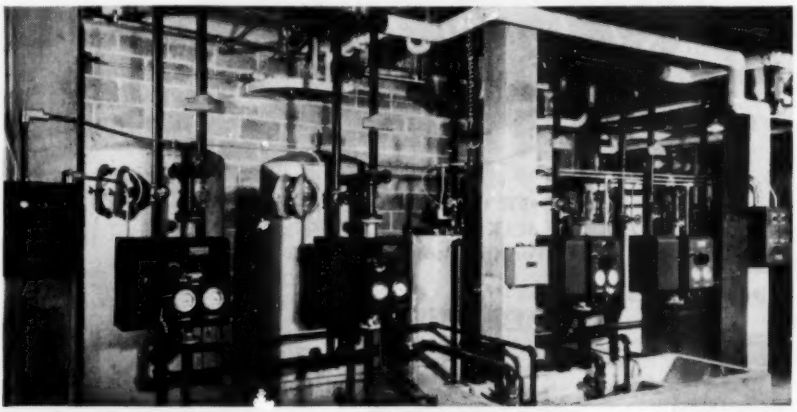
M. B. Cunningham, representing national headquarters, discussed present and future problems facing the water works industry, and stressed the inevitable increase in consumer rate of use and a growing population.

The balance of the morning session was held jointly with the West Virginia Sewage & Industrial Wastes Assn., and a panel discussion on "Stream Quality as It Affects Water Use in West Virginia" was presented. The several topics covered were industrial requirements, bathing, fishing and aquatic life, domestic water supply, and agricultural use.

Following the business meeting on Oct. 3, a field trip was made to the Willow Island Plant of American Cyanamid Co. to observe the waste treatment facilities recently installed to treat wastes from an aureomycin plant. The company also served as host at a cocktail hour which preceded the joint banquet.

The highlight of the banquet was the presentation of the George W. Fuller Award to Lawson Haynes, superintendent of filtration, Charleston District, West Virginia Water Service Co., Charleston. The presentation was made by Vice-President Cunningham, who also presented a Life Membership Certificate to H. P. Musser, president of the West Virginia Engi-

(Continued on page 84)



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(*Continued from page 82*)

neering Co., Charleston. The oldest AWWA membership in West Virginia dates back to 1913 and is held by Scotland G. Highland, general manager of the Clarksburg Water Board. He was not present for the certificate presentation, and it was mailed to him.

The West Virginia Sewage and Industrial Wastes Assn. continued in session on October 4 and many members of the water works group remained for the meeting.

H. K. GIDLEY
Secretary-Treasurer

New York Section: The New York Section held its Annual Fall Meeting at Saranac Inn, Saranac Inn, N.Y., on September 4–5, 1952. During the past few years, the membership of the Section has voted unanimously to have the fall meetings at one of the resort hotels in the Adirondack Mountains. These meetings have proven very successful, and many of the ladies have attended.

As meetings are limited to two days, programs naturally have to be somewhat restricted in their scope. The features of the meeting at Saranac

(*Continued on page 86*)

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(Continued from page 84)

Inn were the presentation of three papers, the first being "Mechanical Joint Pipe" by Thomas F. Wolfe, managing director of the Cast Iron Pipe Research Assn. "Guides for Selection of Dry Feed Machines," was presented by Paul A. Coffman Jr., chief engineer of Omega Machine Co. and M. A. Safford, sales engineer of Wallace & Tiernan Co. "Civil Defense and Water Supply" was the topic of Earl Devendorf, director of the State Bureau of Environmental Sanitation.

A very interesting movie was shown by J. A. Frank, vice-president and general manager of the National Water Main Cleaning Co., with a discussion on "Water Main Cleaning" presented by Larry Griswold, principal engineer of the Utica Board of Water Supply.

The main speaker at the banquet was Neal Bowman of the National Assn. of Manufacturers, whose topic was "Blueprint for Survival." It has been the section's aim to obtain a speaker on the program for at least one of its meetings who will have as a topic something other than a water works subject, and Dr. Bowman's address was very favorably received.

On Friday morning, at the Round Table Conference, the following topics were discussed in detail: The effect of highway and other utility construction on water distribution systems, the allocation of costs and refunds for water main extensions to real estate and industrial developments, plastic service and distribution piping, fluoridation experiences, weather control, and problems caused by the present drought. The discussions were led by John G. Copley, chairman of the Section, in the absence of S. P. Carman, consulting engineer of Binghamton, N.Y.

R. K. BLANCHARD
Secretary-Treasurer

Coming Meetings

AWWA SECTIONS

January 20, 1953—New York Section Winter Luncheon Meeting, at Park Sheraton Hotel, New York, N.Y. Secretary, R. K. Blanchard, Rm. 1922, 50 W. 50 St., New York 20, N.Y.

February 11–13—Indiana Section at Lincoln Hotel, Indianapolis. Secretary, G. G. Fassnacht, State Dept. of Health, 1330 W. Michigan St., Indianapolis 7, Ind.

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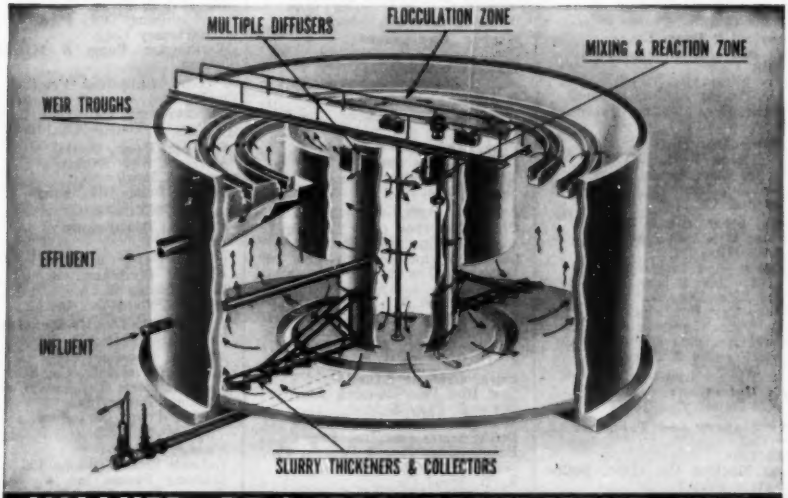

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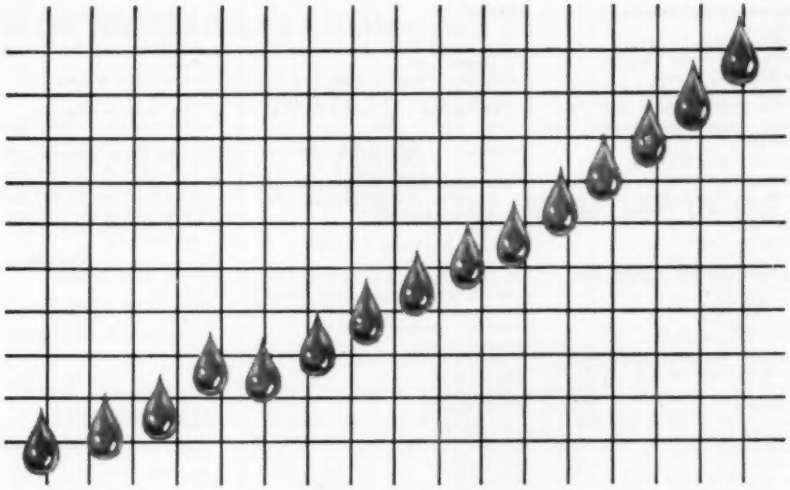

DROPS . . . that boost sewage handling costs

NEVER UNDERESTIMATE the extra load put on a sewage system by simple infiltration of soil water. Pumping costs jump . . . and disposal plant costs climb likewise.

INFILTRATION can be prevented with ATLAS JC-60,® the new plastic base sewer pipe jointing compound. JC-60 provides tight joints, strong as the pipe itself, that prevent unwanted soil water from entering your pipeline—or sewage from escaping.

Other characteristics of JC-60 provide resistant joints that positively stop root penetration—flexible joints that take normal settling without rupture . . . and numerous on-the-job advantages that speed sewer construction and reduce waste.

GET THE COMPLETE FACTS ON ATLAS JC-60. *Write for Bulletin M20-3.*

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. . . a permanent bond

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WATCH DOG WATER METERS

The meter used by thousands of municipalities in the U. S.

"Watch Dog" models . . . made in standard capacities from 20 g.p.m. up: frost-proof and split case in household sizes. Disc, turbine, or compound type.

SURE TO MEET YOUR SPECIFICATIONS FOR ACCURACY, LOW MAINTENANCE, LONG LIFE.

Before you invest in water meters, get acquainted with the design and performance advantages which make Worthington-Gamon Watch Dog Water Meters first choice of so many municipalities and private water companies in the United States.

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Worthington Corporation

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LIST OF ADVERTISERS

A G Chemical Co., Inc. —
Ace Pipe Cleaning Contractors Co., Inc. —
Allis-Chalmers —
American Agricultural Chemical Co. 84
American Brass Co., The —
American Cast Iron Pipe Co. —
American Cyanamid Co., Industrial Chemicals Div. —
American Pipe & Construction Co. 5
American Well Works —
Anthracite Equipment Corp. —
Armco Drainage & Metal Products, Inc. 47
Art Concrete Works —
Atlas Mineral Products Co., The 91
Badger Meter Mfg. Co. —
Barrett Div., The —
Belco Industrial Equipment Div. 23
Bethlehem Steel Co. —
Blockson Chemical Co. 69
Buffalo Meter Co. 18
Builders-Providence, Inc. 9
Burt, Leslie R., Co. —
Byron Jackson Co. —
Calgon, Inc. 15
Carborundum Co., The —
Carlon Products Corp. 21
Carson, H. Y. 18
Cast Iron Pipe Research Assn., The 10–11
Centriline Corp. —
Chain Belt Co. —
Chicago Bridge & Iron Co. —
Clow, James B., & Sons 41
Cochrane Corp. —
Crane Co. 63
Darley, W. S., & Co. —
Darling Valve & Mfg. Co. —
Dearborn Chemical Co. —
De Laval Steam Turbine Co. 67
Dorr Co., The Cover 3
Dresser Mfg. Div. —
Economy Pumps, Inc. —
Eddy Valve Co. 41
Electro Rust-Proofing Corp. 24
Ellis & Ford Mfg. Co. 8
Flexible Sewer-Rod Equipment Co. 13
Ford Meter Box Co., The 49
Foxboro Co., The —
General Chemical Div., Allied Chemical & Dye Corp. 51
Golden-Anderson Valve Specialty Co. —
Greenberg's, M., Sons —
Hammond Iron Works 79
Hays Mfg. Co. 55
Hellige, Inc. —
Hersey Mfg. Co. 31
Hungerford & Terry, Inc. 82
Hydraulic Development Corp. 81
Industrial Chemical Sales Division, West Virginia Pulp & Paper Co. viii
Inertol Co., Inc. 19
Infilco Inc. 95
Iowa Valve Co. 41
Johns-Manville Corp. vi–vii
James Jones Co. 83
Keasbey & Mattison Co. 85
Kennedy Valve Mfg. Co., The —
Klett Mfg. Co. 70
Koppers Co., Inc. 37
Kupferle, John C., Foundry Co. 8
Layne & Bowler, Inc. 59
Leadite Co., The Cover 4
Lock Joint Pipe Co. i
Lovell Chemical Co. —
M & H Valve & Fittings Co. 7
McWane Cast Iron Pipe Co. 17
Mueller Co. 87
National Cast Iron Pipe 41
National Water Main Cleaning Co. 61
Neptune Meter Co. iii
Northern Gravel Co. 66
Northrop & Co., Inc. 22
Omega Machine Co. (Div., Builders Iron Fdry.) —
Pacific States Cast Iron Pipe Co. 17
Peerless Pump Div. —
Pekrul Gate Div., (Morse Bros. Machinery Co.) —
Permutit Co. 39
Phelps Dodge Refining Corp. —
Philadelphia Gear Works, Inc. 14
Pitman Manufacturing Company 65
Pittsburgh-Des Moines Steel Co. 43
Pittsburgh Equitable Meter Div. (Rockwell Mfg. Co.) 96
Pittsburgh Pipe Cleaner Co. 33
Pollard, Jos. G., Co., Inc. 80
Portland Cement Assn. —
Proportioners, Inc. —
Refinite Corp. —
Reilly Tar & Chemical Corp. —
Rensselaer Valve Co. 35
Riches-Nelson, Inc. 38
Roberts Filter Mfg. Co. —
Rockwell Mfg. Co. 96
Rohm & Haas Co. —
Ross Valve Mfg. Co. —
Simplex Valve & Meter Co. 45
Skinner, M. B., Co. 74
Smith, A. P., Mfg. Co., The 75
Smith-Blair, Inc. 53
Solvay Process Div., Allied Chemical & Dye Corp. 34
Southern Pipe & Casing Co. —
Sparling Meter Co., Inc. 78
Standard Electric Time Co. 73
Stuart Corp. 78
Tennessee Corp. 36, 74
U.S. Pipe & Foundry Co. v
Universal Concrete Pipe Co. —
Walker Process Equipment, Inc. 89
Wallace & Tiernan Co., Inc. x, 77
Warren Foundry & Pipe Corp. 57
Well Machinery & Supply Co. 71
Welsbach Corp., Ozone Processes Div. 3
Wood, R. D., Co. Cover 2
Worthington Corp. —
Worthington-Gamon Meter Div. 93

Directory of Professional Services—pp. 25–29

Albright & Friel, Inc.
Alvord, Burdick & Howson
Bays, Carl A. & Assoc.
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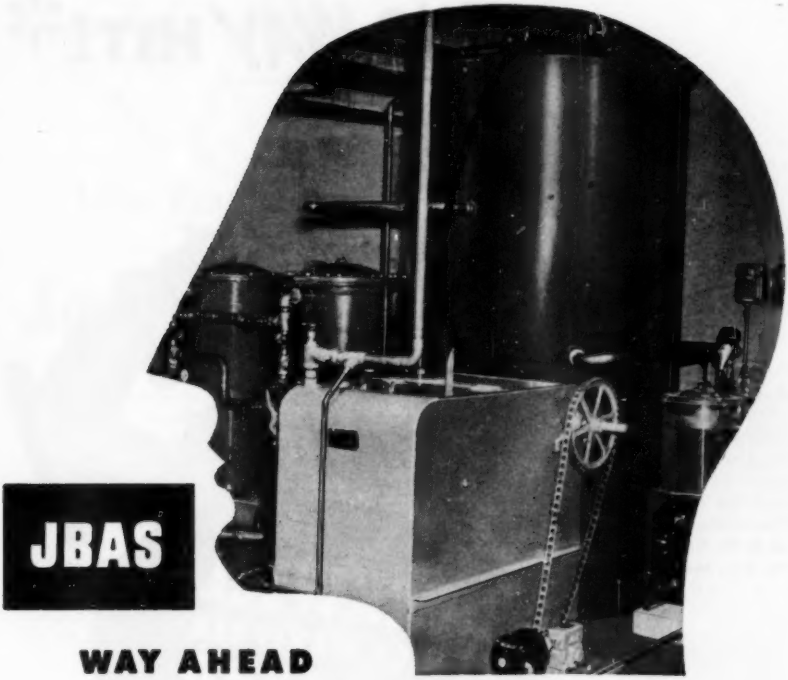

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in water treatment

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The source of water doesn't matter. JBAS versatility has been demonstrated in hundreds of installations treating 5 to 100 gallons per minute... equally effective for softening, clarifying and sterilizing or removing organic matter, tastes and odors... providing a water supply to meet the most exacting standards.

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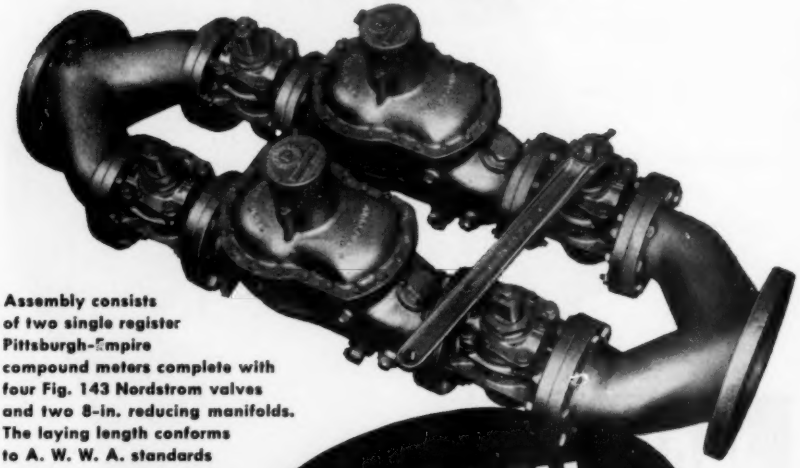

Assembly consists of two single register Pittsburgh-Empire compound meters complete with four Fig. 143 Nordstrom valves and two 8-in. reducing manifolds. The laying length conforms to A. W. W. A. standards for 8-in. compound meters.

ROCKWELL 8-INCH MANIFOLD COMPOUND METER UNIT

*This dual unit is

1. Easier to install and service

2. Assures accurate measurement and long life at low cost

This dual assembly of Pittsburgh-Empire compound meters is easier to handle—the complete unit of meters, valves and piping weighs approximately 100 lb less than a single 8-inch meter. It can be broken down in sections for easy two-man installation. Too, maintenance is simplified since one side of this dual unit can be shut down without service interruption while a new meter or a shop calibrated repaired meter is being installed.

The initial cost for most installations is less! Write for full details.

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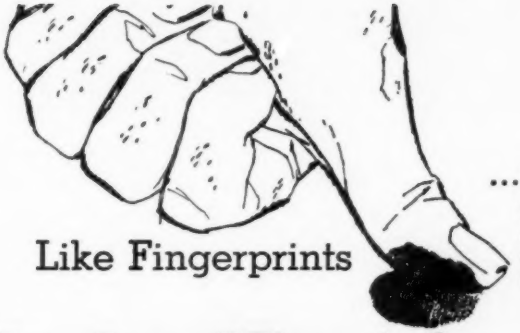


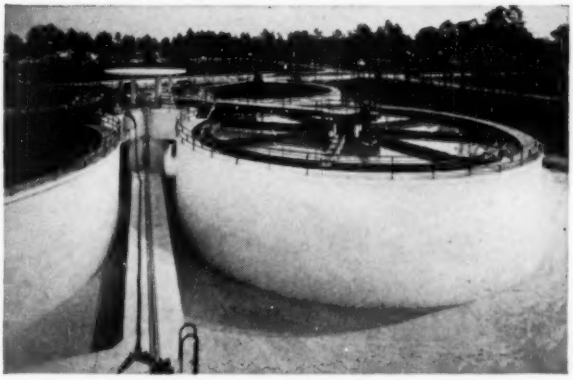
Like Fingerprints

...all water treatment problems are different

Look at Miami, for example -

Problem: To soften peak flow of 52 MGD of ground water at Miami's Southwest Plant.

Solution: Four 69 ft. diameter Dorrco Hydro-Treators* are doing a good job of softening an average flow of 40 MGD — maximum 52 MGD, minimum 10 MGD. Operating guarantees are being exceeded on every count.



This installation is a good example of Dorr's ability to build water treatment equipment designed to accomplish a specific end result. Either high rate units, like the four shown here, or conventional installations . . . all Dorr equipment is designed to provide continuous, positive sludge removal and minimum water loss.

Many types of Dorr equipment, designed for flexibility in solving water treatment problems, are described in Bulletin No. 9141. We will gladly send you a copy. THE DORR COMPANY, Barry Place, Stamford, Conn.

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Every day, nearly 8 billion gallons of water are treated by Dorr equipment.

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Time has proven that LEADITE not only makes a tight durable joint,—but that it improves with age.

The pioneer self-caulking material for c. i. pipe.
Tested and used for over 40 years.
Saves at least 75%

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